



# SCIENCE

8 OCTOBER 1954

VOLUME 120

NUMBER 3119

Biosynthesis of Rubber: <i>J. Bonner, M. W. Parker, J. C. Montermoso</i> .....	549
Nucleotides from T2r <sup>+</sup> Bacteriophage: <i>R. L. Sinsheimer</i> .....	551
Lewis J. Stadler, Geneticist: <i>M. M. Rhoades</i> .....	553

## News and Notes

Friends of Pleistocene Geology; U.S. Geological Survey's Paleontology and Stratigraphy Branch; and Regular Departments .....	554
--	-----

## Book Reviews

<i>Government and Science; Proceedings of Second International Congress on Rheology; Vapor Pressure of Organic Compounds; Tissue Culture as Applied; Copper; Optical Workshop Principles; Matthews' Textile Fibers; Experimental Inorganic Chemistry; Determination of Crystal Structures; Amebiasis; Present State of Physics; Problems of Consciousness; Field Guide to Birds of Britain and Europe; Electronics; Biochemistry of Genetics; New Books; and Miscellaneous Publications</i> .....	563
---	-----

## Technical Papers

The Lake Altus Wave-Cut Surface in the Wichita Mountain Area, Oklahoma: <i>W. F. Tanner</i> .....	571
Nutritional Studies with the White-Throated Wood Rat: <i>R. Van Reen and P. B. Pearson</i> .....	571
A Geothermal Measuring Circuit: <i>J. H. Swarts</i> .....	573
Comparison of Two Methods of Analysis of Rate of Leaf Initiation in <i>Zea mays</i> L.: <i>O. L. Stein and A. V. Weber</i> .....	574
Estrogenic Activity of Some Isoflavone Derivatives: <i>E. Cheng, L. Yoder, C. D. Story, W. Burroughs</i> .....	575
Antiaccelerator and Antiarrhythmic Cardiac Action of Synthetic Steroid Alkamines: <i>S. Margolin, Go Lu, J. Yelnosky, A. Makovsky</i> .....	576

## Communications

Demonstration of Fumarase in Cell-Free Preparations from <i>Paramecium caudatum</i> : <i>G. L. Endahl and K. K. Krueger</i> .....	578
A Fungus Flora of the Sea: <i>D. Ritchie</i> .....	578
Submarine Photography in Puget Sound: <i>J. A. Gast and W. V. Burt</i> .....	579
Effect of Eruption of Hawaiian Volcanoes on the Composition and Carbon Isotope Content of Associated Volcanic and Fumarolic Gases: <i>J. J. Naughton and K. Terada</i> .....	580
Psi and Probability Theory: <i>C. B. Nash</i> .....	581

Appeal from Japanese Evolutionists against the Hydrogen Bomb .....	9A
--	----

Meetings & Conferences .....	11A
------------------------------	-----

AMERICAN ASSOCIATION FOR THE  
ADVANCEMENT OF SCIENCE

file any or all of these



1" MICROSLIDES

or



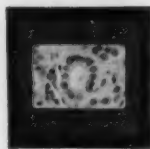
2" MICROSLIDES

or



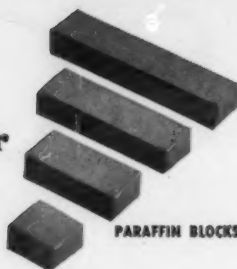
3 1/4 X 4 1/4 LANTERN SLIDES

or

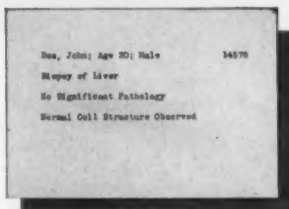


COLOR TRANSPARENCIES

or



PARAFFIN BLOCKS



INDEX CARDS

in easy-to-file,<sup>1</sup> easy-to-find,<sup>1</sup> space-sparing,<sup>2</sup> safe organization<sup>3</sup> and, above all, economically<sup>4</sup> in a

# TECHNICON *Lab-aid*

laboratory filing cabinet

- ① patented "Lab-aid" spring separators let you riffle slides like book pages • the one you're seeking pops right into sight.
- ② a stack of "Lab-aid" cabinets needs only 19" x 19" floor space.
- ③ steel fireproof construction and true-tracking design brings drawers straight out • slides don't crush against frame. Nor can drawers pull out accidentally and crash on floor.
- ④ a single 14 drawer section will accommodate up to 6500 microslides.

Technicon LAB-AID is more than a simple cabinet . . . it is an integrated filing system which brings order and efficiency to every laboratory filing need. Write today for detailed information.

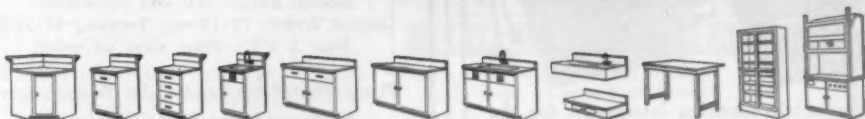
The **Technicon** Company  
215 East 149 St., New York 51, N. Y.

"Lab-aid" Cabinets are manufactured by our French Corporation  
COMPAGNIE TECHNICON • 7 rue Georges Ville • Paris



# moduline

SECTIONAL STEEL  
LABORATORY  
FURNITURE



**Easiest, Most Economical Way to Install Cabinets and Casework**



Standard widths and depths permit easy adaptation to any floor plan. Variety of units give you unlimited possibilities for arrangement.

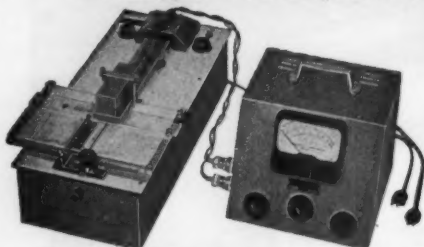
Moduline has made the planning and installation of laboratory fixed equipment a low-cost problem. No expensive preliminary planning or high-priced technical skills are required. Moduline also lends itself easily to expansion or it may be moved entirely to a larger location, should the need for added facilities later be felt. Moduline consists of drawer units, cabinets, sinks, work tables, etc. All units are available in 24, 35 or 47-inch widths, making it possible to plan installations of any size. The line drawings above show only a few representative Moduline units. Arrangements of such units in the laboratory practically suggest themselves, according to your needs. The photographs shown are of actual Moduline installations. Continuous, interrupted and island-type plans such as these can be quickly carried out. Sink units are available with basins of stainless steel or Alberene stone. Tops and splashbacks are all of stainless steel; the body structures are of electrically welded steel. Our planning department is prepared to submit suggested room layouts and provide you with cost estimates for your Moduline equipment. Write for descriptive brochure.

**aloe scientific** DIVISION OF A. S. ALOE COMPANY

LOS ANGELES 15	•	5655 Kingsbury	•	St. Louis 12, Missouri	•	NEW ORLEANS 12
1150 S. Flower St.	•	SAN FRANCISCO 5	•	SEATTLE 1	•	1425 Tulane Ave.
MINNEAPOLIS 4	•	500 Howard St.	•	1920 Terry Ave.	•	WASHINGTON 5, D. C.
927 Portland Ave.	•	KANSAS CITY 2	•	ATLANTA 3	•	1501 14th St., N. W.
	•	4126 Broadway	•	492 Peachtree St., N.E.	•	



## PHOTOVOLT Densitometer for Partition Chromatography and Paper Electrophoresis



A photoelectric precision instrument for the rapid and convenient evaluation of strips and sheets of filter paper in partition chromatography and paper electrophoresis

Write for Bulletin #800 to

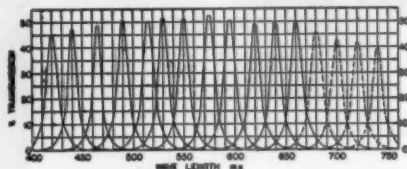
**PHOTOVOLT CORP.**  
95 Madison Ave. New York 16, N. Y.

Also: Colorimeters | pH Meters | Multiplier Photometers  
Fluorimeters | Nephelometers | Interference Filters

## G.A.B. Interference Filters

(Made in Switzerland)

for isolating narrow spectral bands



Spectral Range: 400-900 millimicrons  
Spectral Width: 12-15 mμ, Transm.: 45-50 %  
Size: 2" x 2". Other sizes on order.

For

Flame Photometry and Color Densitometry  
Microscopy and Photomicrography  
Colorimetry and Fluorimetry

also in reflectometry, light scattering measurements, microcolorimetry, refractometry, polarimetry, and in all other fields requiring monochromatic light in the visible and near-infrared range.

Write for Bulletin #180 to

**PHOTOVOLT CORP.**  
95 Madison Ave. New York 16, N. Y.

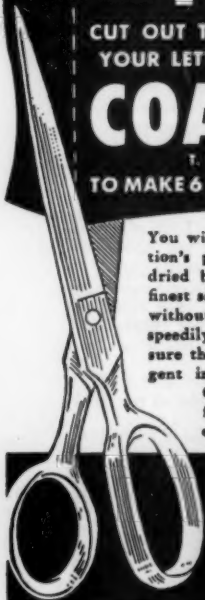
# FREE!

CUT OUT THIS AD AND PIN IT TO  
YOUR LETTERHEAD FOR ENOUGH

# COAGUSOL

T. M. REG. U. S. PAT. OFF.

TO MAKE 6 GALLONS OF SOLUTION!



You will find that a COAGUSOL solution's penetrating action strips stains, dried blood and tissue from even the finest serration of surgical instruments, without soap, without scrubbing—speedily, economically. Because we are sure that you will find this new detergent invaluable—we ask you to try COAGUSOL at our expense. For full information and your generous sample, write right now to

**HOSPITAL LIQUIDS**  
*Incorporated*  
PRODUCTION LABORATORIES  
Milledgeville, Georgia

## \*\*\* SCIENCE - 1954 \*\*\* ON MICROCARDS

The response to the 1953 Microcard edition has encouraged us to make volume 119 of SCIENCE available in this form. Thirty-nine 3" x 5" cards contain all 1,512 pages of SCIENCE from January through June 1954.

The space saving is considerable. 25 sets of Microcards take up approximately the same space as a single bound volume of SCIENCE covering the same period. The bother and expense of binding is completely eliminated. In spite of a 14% increase in volume, the price remains unchanged:

Microcard edition of SCIENCE, 1953 \$15.00  
" " January-June 1954 \$ 7.50

Orders may be placed with:

\*\*\*\*\*  
AAAS  
1515 Mass. Ave., N.W.  
Washington 5, D. C.  
\*\*\*\*\*

# SENSATIONAL OPTICAL BARGAINS



## OPTICAL COLLIMATOR

This instrument, an item of war surplus, was originally designed to check navigational instruments. It is being used by industry as a collimator for optical instruments, for

testing lenses for definition, as a source of infinite light, and for photographing reticles at infinity. It is also being purchased by many firms as a source for the fine lenses and parts it contains. Consists of a large cemented achromat, 5" in diameter, with a focal length of approximately 25", a pin point reticle lighted by a 6-8 volt bulb (to represent a star), a first-surface mirror to reflect the light from the reticle. Overall length 14 1/2"; width of cradle 7 1/2". Slightly used, but guaranteed in good working order. Ship. wt. 15 lbs. Stock No. 80,025-W ..... \$95.00 f.o.b. Barrington, N. J.

## New! 2 in 1 Combination! Pocket-Size 50 POWER MICROSCOPE and 10 POWER TELESCOPE ONLY \$4.50 ppd.



Useful Telescope and Microscope combined in one amazing, precision instrument. Imported! No larger than a fountain pen. Telescope is 10 Power. Microscope magnifies 50 Times. Sharp focus at any range. Handy for sports, looking at rare objects, just plain snooping.

Order Stock #30,059-W \$4.50 ppd.

Send Check or M.O.  
Satisfaction Guaranteed!

## IMPORTED MICROSCOPE 100, 200, 300 Power



1 Ocular, 3 Objective Lenses, Rack & Pinion Focusing Revolving d-e-light adjustable mirror. Square stage 2 1/2" x 2 1/2". Truly a wonderful bargain. TRY IT FOR TEN DAYS—if not completely satisfied, your money refunded. Comes packed in sturdy, hardwood case. Accessory eyepieces and objective available.

Stock No. 70,008-W ..... \$14.95 Postpaid  
**FREE!** Clip this ad for 93-page book "Hunting With the Microscope" sent free! Regular advertised price 60¢. Limited time only!

## ASTRONOMICAL TELESCOPE KIT



### Mt. Palomar Type Telescope

All optical parts completely finished—only require mounting (no metal parts included). Kit consists of 6 1/2" aluminum F/11 reflecting mirror—lenses for eyepiece—front surface mirror for diagonal. Mirror in kit is guaranteed to give the theoretical maximum definition. This combination will give you a 45 power telescope, which power is best for all around viewing. Finished instrument will be worth \$75 to \$100. By using supplementary eyepieces, available at small extra cost, you can get up to 190 power. Directions included.

Stock No. 50,074-W ..... \$16.25 Postpaid



**IF YOU'RE INTERESTED IN OPTICAL BARGAINS  
Write for FREE CATALOG W**

We Have literally Millions of War Surplus Lenses and Prisms for Sale at Bargain Prices. Numerous Types of Instruments Too!

**EDMUND SCIENTIFIC CORP., BARRINGTON, N. J.**



## STEREO MICROSCOPE

WITH CHANGEABLE OBJECTIVES

Now! Depth in a Magnified Erect Image! Fine, imported Bicolor Microscope at a substantial saving. Used for inspections, examinations, counting, checking, etc. Erect image. 2 pairs of eyepieces. 2 pairs of objectives. Power ranges from 13X to 75X. Variable Interocular distance. Will accommodate standard eyepiece reticles. Rack and pinion variable tension focusing. Hardwood carrying case included. Accessories available. Recommended for lab, shop, factory or home use. We guarantee complete satisfaction.

Order Stock No. 70,036-W ..... \$95.00 Postpaid  
Rush check or M.O. or order on open account

Optical Parts from \$12,000 U.S. Govt. Height Finder—Mounted Objective, Penta Mirror Assemblies, Eyepiece Assemblies, etc. Write for Bulletin #25-W

## SPITZ JR. PLANETARIUM

One of the Greatest Scientific  
Toys We Have Ever Offered!

Designed by Armand Spitz, world-famous maker of the Spitz Planetarium. Projects nearly 400 stars, more than 70 constellations in their correct relationships. Use it in any darkened room of the home, project it on the ceiling. No batteries, works on ordinary household current. Two simple adjustments that show you the sky as it appears from any point in your hemisphere... for any month of the year! Rheostat control for brightness. 32-page book included free of extra cost. Contains valuable information about the stars, provides easy identification of the constellations.

About 14" high on a 7" base. Projection sphere 7" diameter. Weight 3 lbs. Stock No. 70,040-W ..... \$15.00 Postpaid



## SPECTRAL LAMPS The Famous German OSRAM SERIES



SPECTRAL LAMPS (Famous German Osram Series) Used in instruments requiring a monochromatic light source or a segment of the spectrum. All lamps fit a standard medium prefocus socket. Supply voltage: 220 A.C. Amperage: 1.0 to 3.5.

Stock No.	Vapor	Price Paid.	Stock No.	Vapor	Price Paid.
50,054-W	Cadmium	\$29.20	50,060-W	Sodium	\$29.20
50,055-W	Cesium	29.20	50,061-W	Neon	29.20
50,056-W	Helium	29.20	50,062-W	Rubidium	29.20
50,057-W	Mercury	29.20	50,063-W	Thallium	29.20
50,058-W	Mercury Cadmium	32.30	50,064-W	Zinc	29.20
50,059-W	Potassium	29.20	50,065-W	Mercury Sulphide	38.48

## 60° SPECTROMETER PRISM

Polished surfaces flat to 1/4 wave-length. Angle tolerances 5 minutes. Dimensions of polished surfaces 18mm. x 30mm. Made from dense flint glass, free of strain and stress. Ideal for use with all models of spectrometers.

Stock No. 80,143-W ..... \$6.25 Postpd.

## INFRA-RED LIGHT AND ITS USES

16 page illustrated Booklet dealing with all phases of Infra-Red projects—including Telescopes, Infra-Red microscopy, photography, watch-dog systems and communications. Includes list of materials.

Stock No. 9040-W ..... 75¢ Postpd.

## LOOK! INFRA-RED ITEMS!

### INFRA-RED FILTERS — 5 1/2" dia.

For use with infra-red telescopes, camera attachments, etc. Light from a 100-watt bulb passing through the filter is transformed to infra-red light source. Used on jeep headlights with infra-red driving instruments. 1/4" thickness. Stock No. 60,033-W ..... \$2.00 ea. Postpd.

### INFRA-RED IMAGE TUBE

Used inside an infra-red telescope, this miniature tube converts infra-red rays to visible rays on the tube screen, which is viewed by an ocular. British import. Cylindrical shape, approximately 2" diameter, 1 1/4" long. Requires standard vibration electrical source.

Stock No. 50,046-W ..... \$7.95 Postpd.

**ORDER BY STOCK NO. Satisfaction Guaranteed  
Send Check or M. O.**

SCIENCE is published weekly by the AAAS, 1515 Massachusetts Ave., NW, Washington 5, D. C. Entered at the Lancaster, Pa., Post Office as second class matter under the act of March 3, 1879. Annual subscriptions: \$7.50; foreign postage, outside the Pan-American Union, \$1; Canadian postage, \$0.60.

## pH CONTROL CHLORINE CONTROL PHOSPHATE CONTROL

maintained with  
accuracy, simplicity & low cost  
by the

### LaMOTTE COMPARATOR METHOD



These time-tested instruments have served Science and Industry for more than 31 years.

Consult LaMotte for a complete line of simplified Equipment & Reagents for:

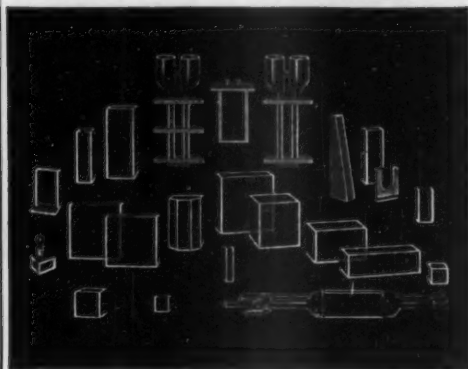
pH Control, Chlorine Control, Boiler Feed Water Control, Analysis of Water, Sewage, and Industrial Wastes, Control of Electroplating Baths & Cleaning Solutions, Soil Testing, Vitamin Studies.

LaMOTTE CHEMICAL PRODUCTS CO.

Dept. H

Towson, Baltimore 4, Md.

## GLASS ABSORPTION CELLS made by KLETT



Makers of Complete Electrophoresis Apparatus

### SCIENTIFIC APPARATUS

Klett-Summerson Photoelectric Colorimeters—  
Colorimeters—Nephelometers—Fluorimeters—  
Bio-Colorimeters—Comparators—Glass Stand-  
ards—Klett Reagents.

Klett Manufacturing Co.

179 East 87 Street, New York, New York

# DENTAL CARIES and FLUORINE

7½ x 10½, clothbound, double column, XI + 111 pages

### FROM THE CONTENTS:

H. Trendley Dean	Epidemiological Studies in the United States
Robert Weaver	Epidemiological Studies in the British Isles and India
T. Ockerse	Fluorine and Dental Caries in South Africa
Philip Jay and	Epidemiological Aspects of Oral Lactobacillus Counts in Fluoride
Francis A. Arnold, Jr.	and Non-Fluoride Areas
Wallace D. Armstrong	Chemical Differences of Caries Susceptible and Immune Teeth
	and a Consideration of Food Sources of Fluorine
Harold C. Hodge and	Experimental Caries and a Discussion of the Mechanism of Caries
Reidar F. Sognnaas	Inhibition by Fluorine
F. J. McClure	Nondental Physiological Effects of Trace Quantities of Fluorine
B. G. Bibby	Topical Applications of Fluorides as a Method of Combatting
	Dental Caries
Francis A. Arnold, Jr.	The Possibility of Reducing Dental Caries by Increasing Fluoride
Abel Wolman	Ingestion
	Fluorine and the Public Water Supply

Published in 1946, this volume is attracting increasing attention today. \$3.50—Cash order price to AAAS members \$3.00



TO: AAAS, 1515 Mass. Ave., N.W.  
Washington 5, D. C.

Enclosed is \$..... Please accept my order for

..... DENTAL CARIES AND FLUORINE

Name .....

Address .....

City ..... Zone ..... State .....

ORDER NOW

**PHIPPS & BIRD**

# **VARI-PHASE VALVE**



**FOR CONTROLLING ARTIFICIAL RESPIRATION**

This valve in conjunction with a source of compressed air is used to control artificial respiration.

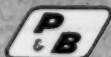
Control of one knob facilitates respiration rates of 15 to 50 per minute. The inspiration to expiration time ratio may be set to any value between 1:4 to 4:1. By loosening one screw the valve may be removed for cleaning and sterilizing.

For operation on 115-volt, 60-cycle only.

CAT. NO. 71-216

\$125.00

## **PHIPPS & BIRD, INC.**



MANUFACTURERS AND DISTRIBUTORS OF SCIENTIFIC EQUIPMENT

5TH & BYRD STREETS — RICHMOND, VA.

## THE Reco

### FRACTION COLLECTOR FOR CHROMATOGRAPHY

RECO Fraction Collector set up for collection on a time-flow basis with four chromatographic columns operating simultaneously.



RECO Fraction Collector set up for volume collection from one column into 400 test tubes.



#### Check these important features offered by the new RECO Model F1200:

TWO METHODS OF COLLECTION... timed-flow and volumetric. FULLY AUTOMATIC... whether set for timed-flow or volumetric operation. COLLECTS UP TO 400 SAMPLES... resulting in sharper differentiation of components. READILY INTERCHANGEABLE RECEIVER PLATES... affording widely varied volumes per fraction. FOUR CHROMATOGRAPHIC COLUMNS CAN BE OPERATED SIMULTANEOUSLY... each delivering into an individual row of tubes. COLLECTS SAMPLES ON A VOLUME BASIS AS SMALL AS 3 cc... and up to 90 ml. with standard receiver plates. Timed Interval Between Tubes from 30 Seconds to 50 Minutes. Samples in Full View for Ready Observation. ACCURATE... and Completely Dependable in Performance.

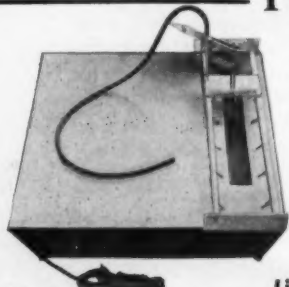
STANDARD EQUIPMENT: Stand with four stainless steel support posts. Heavy duty worm gear reduction motor with indexing mechanism. Two receiver plates: one holding 400 13 mm tubes, the other 100 25 mm tubes. Three volumetric assemblies (3 ml., 5 ml., and 10 ml.). Timer/Controller.

PRICE: RECO Model F1200 Fraction Collector, complete \$525.00

Write for Brochure F-10

## THE Reco

### SAMPLE APPLICATOR FOR PAPER CHROMATOGRAMS



Write for Brochure F-15

The new RECO Sample Applicator simplifies and speeds up application of samples to paper chromatograms. Enables application in controlled amounts and prevents spreading of sample on paper. With the RECO Sample Applicator inexperienced workers can do uniform spotting giving consistent results. Eliminates considerable variability when several individuals do the spotting, as may be the case where samples of many field replications are involved.

Literature describing the complete line of RECO Paper Partition Chromatographic Equipment and Supplies sent on request.

MANUFACTURER

**RESEARCH EQUIPMENT Corporation**

1135 THIRD STREET • OAKLAND, CALIFORNIA

## NEW CLASSROOM MICROSCOPE for

### General Biology

Sold on 10 days approval. Satisfaction Guaranteed  
Model GB<sub>2</sub>

Equipped with:  
10x Ocular  
Objectives,  
16 mm (10x) n.a. 0.27  
4 mm (44x) n.a. 0.66  
Disc Diaphragm  
Plano-concave mirror  
Coarse adjustment  
Full range fine adjustment

**\$118.00**

Less 10% on 5 or more.

Write for catalogue



MODEL GB<sub>2</sub>

### INSIST ON THIS FULLY EQUIPPED INSTRUMENT

A trial in your laboratory will convince you of the high quality, beautiful design and practical features. No obligation to purchase if you are not as enthused about this instrument as we are.

## THE GRAF-APSCO CO.

5868 Broadway

Chicago 40, Ill.

# Radio - Active STEROIDS

IMMEDIATELY  
AVAILABLE

## ESTRONE 16-C<sup>14</sup>

Activity per mg.  
2.7 microcuries  
Price per mg. \$50.00

## ESTRADIOL 16-C<sup>14</sup>

Activity per mg.  
2.7 microcuries  
Price per mg. \$65.00

## PROGESTERONE 21-C<sup>14</sup>

Activity per mg.  
2.25 microcuries  
Price per mg. \$40.00

## DESOXYCORTICOSTERONE ACETATE 21-C<sup>14</sup>

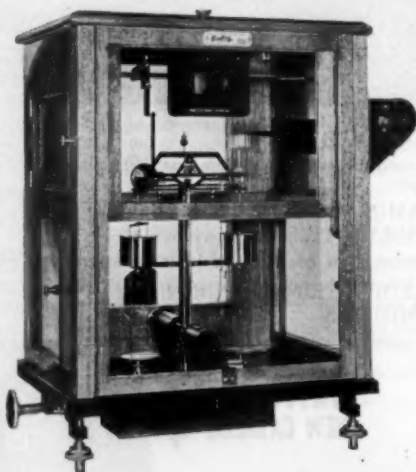
Activity per mg.  
2.25 microcuries  
Price per mg. \$40.00

Statement of your government department dealing with atomic energy together with "Atomic Energy of Canada Limited Form No. 247" should be filled with each order.

For these forms and other information, write to:

Charles E. Frossi & Co. . . .  
PHARMACEUTICAL and CHEMICAL  
MANUFACTURERS

P.O. BOX 247  
MONTREAL, CANADA



## OERTLING (London)

Micro and Semi Micro Balances with  
Chromnickel Beam  
Mechanical Fraction Loading  
Air Damping  
Projection Reading

The ideal balances for the truly discriminating micro chemist!

Model 141 direct reading to 10 gamma  
capacity 30 grams . . . . . \$ 950.00

Model 142 direct reading to 1 gamma  
capacity 20 grams . . . . . \$1040.00

C. A. Brinkmann & Co.

378-380 Gr. Neck Road  
Great Neck, L. I., N. Y.

Now in stock for immediate delivery!

Complete Repair Service for All Balances!

## More Precision in Air Conditioning

Niagara "Controlled Humidity" Method provides air at precise conditions of temperature and moisture content.

In the range from below 32° F. to 140° F. you may have constant conditions within tolerances of 1° F. and 2% R. H. with control by thermostats alone... simple and inexpensive... no moisture sensitive instruments needed.

This Method uses "HYGROL" liquid absorbent to remove moisture from the air directly. Operation is automatic; the absorbent is re-concentrated, by a new, reliable method, at the same rate as it becomes diluted.



Use it for drying processes, preventing moisture damage to instruments or hygroscopic materials, controlled atmospheres for tests and experiments. Unit capacity ranges up to 20,000 c. f. m.

Write for Bulletins No. 121, 122, 125; address Niagara Blower Co., Dept. SW 405 Lexington Ave., New York 17, N. Y.

## Carworth Farms, Inc.

Laboratory animals and laboratory reagents

*First in uniformity*

*First in dependability*

For further information and price list please write:

**CARWORTH FARMS, INC.**

NEW CITY, ROCKLAND COUNTY, N. Y.

## RESEARCH BIOCHEMICALS OF HIGHEST POSSIBLE PURITY

"VITAMIN FREE" CASEIN  
(Hot Alcohol Extracted)

A valuable source of protein nitrogen of exceptional purity for incorporation into diets to produce vitamin deficiencies.

MISCELLANEOUS  
BIOCHEMICALS

OVER 1200 ITEMS



**NUTRITIONAL BIOCHEMICALS  
CORPORATION**

21010 MILES AVENUE • CLEVELAND 28, OHIO

## FOR INVESTIGATIONAL USES

### AMINO ACIDS

A complete selection of more than 100 amino acids.

### "VITAMIN FREE" CASEIN HYDROLYSATE

Pre-tested for microbiological vitamin assays.

### NUCLEOPROTEINS — PURINES PYRIMIDINES

A complete selection of all derivatives.

**WRITE FOR  
NEW CATALOG**





#### AAAS EDITORIAL BOARD

Duane Roller

Editor

Charlotte V. Meeting

Assistant Editor

Mark H. Adams Bentley Glass  
William R. Amberson Karl Lark-Horovitz  
Wallace R. Brode Edwin M. Lerner  
William L. Straus, Jr.

Advertising Representative: F. A. Moulton

### Appeal to the Western Evolutionists against the Hydrogen Bomb by the Japanese Society for the Study of Organic Evolution

Dear Sir:

We are sending this letter to you with our heartfelt appeal to your sympathy for the inestimable victims due to the recent atomic weapons. It is only five years since we read one of Dr. Muller's excellent papers "Our load of mutation" with deep impression. As he pointed out there and elsewhere, factors increasing the load have become accumulated with the advancement of civilization. Based on his research on the estimation of the critical values of the frequency of human mutation, it is hoped to realize in future the possibility of finding out some effective ways of mutation prophylaxis toward the progress of human beings.

It is our duty, as pointed out by Dr. Jepsen, to transmit the chromosomes received from our ancestors, without a bit of injury. Since the last war, or more precisely the fall of the atomic bomb, biologists are making a progress in their thought that biological science can not be separable from the ethics concerning the evolution of human society and wisdom. For further proper evolution, one needs no more Hiroshimas, no more Nagasakis.

You know well that the price we paid was more than enough. It is to be regretted, however, much more costly prices have been forced to be paid again and again in such time of peace as this. The air of the stratosphere has been filled with radioactive dusts that will fall on the ground with wind, rain and snow. The waters of tropical Pacific Ocean have been contami-

nated with molecules emitting ionizing radiations. These radiations have inflicted and will continue to inflict direct and indirect injuries upon mankind, realizing the conditions which we, and of course you also, are afraid of being brought as the results of the atomic fission and fusion if these were operated without our good sense.

"The facts of atomic fission could lead to the fusion of knowledges into social wisdom," Dr. Jepsen says. Then, would the facts of atomic fusion lead to fissure the wisdom into the vacuum over the stratosphere, bringing about the destruction of human society?

It is time to appeal for the abeyance of attempts of such tremendous destruction. We hope that you, the Western evolutionists, would take the leadership of this appeal, because you are the men most conscious of the destructive influence due to the radiation upon the life on the earth.

Very sincerely yours,

ICHIRO HAYASAKA, *President,*

*Japanese Society for the Study of Organic Evolution*  
*Faculty of Science, Hokkaido University,*  
*Sapporo, Japan*

*An open letter, dated 1 May 1954, received by many geneticists and evolutionists in the United States, and probably also in other countries of the world, from their Japanese colleagues.*

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at Business Press, Lancaster, Pa. SCIENCE is indexed in the *Reader's Guide to Periodical Literature*.

All correspondence should be addressed to SCIENCE, 1515 Massachusetts Ave., NW, Washington 5, D. C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors.

**Change of address:** The notification should reach us four weeks in advance. If possible, please furnish an address stencil label from a recent issue. Be sure to give both old and new addresses, including postal zone numbers, if any.

Annual subscriptions: \$7.50; foreign postage, outside the Pan-American Union, \$1.00; Canadian postage, 50¢. Single copies 25¢. Special rates to members of the AAAS.

The AAAS also publishes THE SCIENTIFIC MONTHLY.

# Rapid centrifugal preparation

with the *Spinco* Model L

## ULTRACENTRIFUGE

- **VACUUM**
- **162 ml - 40,000 rpm**
- **REFRIGERATED**



**FULLY-AUTOMATIC** features make the Spinco Model L Preparative Ultracentrifuge operationally self-supervising. Simple speed- and time-controls are preset by operator and electronic unit brings rotor to speed, times run, and decelerates with smoothly operating automatic brake.

Various sizes and types of interchangeable rotors mount in operating chamber with instantaneous coupling. Time between runs, using pre-loaded rotors, is less than a minute. Speed and vacuum are established almost simultaneously. Acceleration time for the 40,000-rpm rotor is only four minutes.

**SAFETY FEATURES** include automatic overspeed cutout; interlocks to prevent running at high speeds without vacuum in chamber and prevent breaking vacuum or opening chamber while running at high speeds. Rotor chamber is encased in thick double steel guard.

UNIT IS SELF-CONTAINED, of worktable height, and requires only electric connection for installation. Spinco electric drive and gearing system are of types proved in more than 100,000 hours of actual field operation. Self-balancing feature eliminates weighing of loaded tubes. Controllable refrigeration holds rotors and contents at any temperature down to -5 C.

In operation, the Model L applies forces up to 144,000 times gravity on 162 ml of material at a maximum speed of 40,000 rpm. Individual rotor tubes have sealing caps—are available in plastic or metal. Rotors provide second vacuum seal in quickly-detachable cover with integral lifting device. Wide selection of rotors is available with largest holding 1700 ml—

Send for  
details

**SPECIALIZED INSTRUMENTS CORPORATION**  
605 O'NEILL AVE • BELMONT, CALIFORNIA



# Biosynthesis of Rubber\*

James Bonner

*Kerckhoff Biological Laboratories, California Institute of Technology, Pasadena*

Marion W. Parker

*Rubber Plant Investigations, Field Crops Research Branch,  
U.S. Department of Agriculture, Beltsville, Maryland*

Juan C. Montermoso

*Rubber Branch, QM Research and Development Center, Natick, Massachusetts*

**D**ESPITE all the knowledge available concerning the production of various types of synthetic rubber, no elastomer has yet been produced that has the low heat build-up or low hysteresis of natural rubber. This property is essential for making large size heavy-duty tires. If it were possible to produce synthetic rubber possessing this desirable property, it would no longer be necessary to maintain a large stockpile of natural rubber. The current carrying charge for the strategic natural rubber stockpile is about \$20 million a year. It has been authoritatively stated that "Since the major current requirement for natural rubber is for use in large truck tires, a long-range program to develop and apply synthetic rubber for this purpose presents the only possibility of greatly reducing the Nation's dependence on natural rubber" (1).

Many chemical approaches have been tried without success in an effort to find a synthetic equivalent for natural rubber. The present program is a biochemical one. We are finding out the processes involved in the formation of rubber in the living plant. It is hoped that the knowledge obtained may give us new and novel approaches to the development of low heat build-up synthetic rubbers.

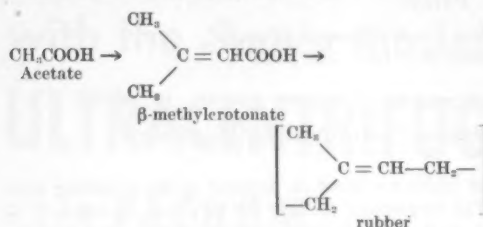
Two related investigations are currently under way. One at the California Institute of Technology has to do with the study of rubber synthesis by plant enzyme systems. The other, carried on by the U.S. Department of Agriculture, is concerned specifically with rubber synthesis by the rubber tree, *Hevea*. The U.S. Department of Agriculture is also cooperating in the Argonne National Laboratory, Illinois, on production of  $C^{14}$ -labeled natural rubber.

*Synthesis of rubber in the living plant.* Natural rubber is, of course, a polymer made of repeating isoprene units. Each isoprene unit contains one double bond, and in natural rubber these double bonds all have the *cis*-configuration. This structure has not been duplicated outside of the living plant. It is the all-*cis*-configuration, together with the nature of the monomer, that presumably is responsible for the low hysteresis or low heat build-up properties. It may be noted that rubber is only one of a general class of compounds known collectively as the isoprenoids, all

of which are based on isoprene as the repeating unit. The isoprenoids include the terpenes, in which 2, 3, 4, or 6 of the 5-carbon isoprene units are bound together in a single molecule; the carotenoids, in which 8 of the 5-carbon units are bound together; and the polyisoprenoids, which include rubber and gutta-percha. All plants synthesize one or another of the isoprenoids. Thus, carotenoids and phytol, the long-chain alcohol that is a component of the chlorophyll molecule, are universal components of higher plants. A few kinds of higher plants, about 4000 of a total of 400,000 or so species, make large quantities of one or another terpene or polyisoprenoid. In some cases, the lower terpenes are accumulated as a so-called "essential oil" (the turpentine of pine trees). In other cases, it is rubber that is accumulated, as the rubber of *Hevea*, guayule, or other species. So far as we can ascertain at the present time, neither rubber nor the lower terpenes have any essential function in the plant (2). They appear to represent a storing away of the basic 5-carbon unit in forms that are not usable by the plant. Thus, neither rubber nor the lower terpenes, once made, are utilizable as food material by any higher plant that has been investigated.

If we are to discover how plants make isoprenoids, it is first necessary to discover the 5-carbon monomer used by the plant. The monomer cannot be isoprene itself, since this has not been found to occur in plants. This question was first intensively studied with the guayule, a shrub that produces large quantities of rubber within individual cells. It has been shown (3, 4) that it is possible to cause small pieces of the branches of guayule, or even seedlings of this plant, to make additional rubber if they are supplied with appropriate carbon-containing compounds. It has been shown that the simple 2-carbon compound acetate forms the source of all the carbon atoms used in making rubber by the guayule plant. If we supply radioactive  $C^{14}$ -labeled acetate to the plant, it makes rubber in which every carbon atom is labeled with  $C^{14}$  (5, 6). Thus, acetate forms the basic precursor. Yet this 2-carbon compound must somehow be made into a 5-carbon branched-chain compound of the structure of isoprene. The nature of the 5-carbon compound is suggested by the fact that the substance  $\beta$ -methylcrotonic acid pos-

sesses the ability to support efficiently rapid rubber formation in guayule (3). That  $\beta$ -methylcrotonate is formed from acetate is indicated by the fact that when plants are fed  $C^{14}$ -labeled acetate, they synthesize  $C^{14}$ -labeled  $\beta$ -methylcrotonate (6). The general course of rubber synthesis in the guayule may therefore be as suggested in the following equation.



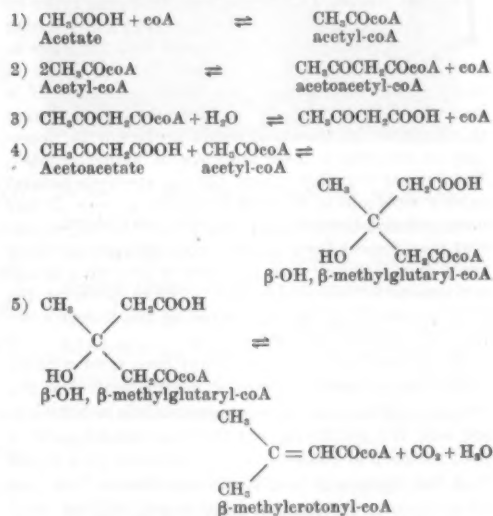
One might object that the guayule is only one rubber plant and other species, such as *Hevea*, might synthesize rubber by some different pathway. Experiments similar to those discussed in preceding paragraphs have, therefore, been made with *Hevea* by H. J. Teas at the U.S. Department of Agriculture Laboratory in Mayaguez, Puerto Rico. It is not possible to test the effect of added substances on rubber synthesis in *Hevea* by simply injecting the test substance into the latex system and subsequently determining the amount of rubber in the latex collected from a test tap. Compagnon and Tixier (7) have shown that injections of such nonspecific substances as copper sulfate greatly increase the flow of latex and, therefore, the yield of rubber in trees being tapped by commercial methods. In the present work, the test substances are applied in holes drilled in squares of bark that have been isolated from the rest of the latex system by deep cuts. After an appropriate period, samples of the bark are removed and analyzed for total rubber. Applications of either acetate or  $\beta$ -methylcrotonate have resulted in apparent increases in rubber synthesis in *Hevea* bark. The increases are considerable, amounting to as much as 50 percent or more. Other substances tested had little or no influence on rubber synthesis.

N. J. Scully and his group at the Argonne National Laboratory have developed facilities that permit the growth of plants under completely controlled environmental conditions and in an atmosphere of radioactive  $C^{14}O_2$ . Small *Hevea* trees have been grown in this fashion and the latex collected periodically. The uniformly labeled rubber obtained is available for the study of technologic matters. These experiments indicate that there is a time lapse of several hours between the introduction of  $C^{14}$  to the leaf and its appearance in the rubber hydrocarbon.

**Enzymology of rubber formation.** It has been mentioned in a preceding paragraph that  $\beta$ -methylcrotonate is able to support rubber formation in the plant and that this 5-carbon acid may therefore be an intermediate in the formation of the isoprenoid monomer. We now have two problems: (i) how do  $\beta$ -methylcro-

tonate and the monomer get made from acetate, and (ii) how is the monomer polymerized?

In order to find out more about these matters, it has been necessary to work not with intact plants fed with particular compounds or particular carbon<sup>14</sup>-labeled radioactive compounds but with isolated plant enzyme systems. It should be possible in principle to trace the path of acetate carbon atoms to rubber by identifying the enzymatic steps responsible for the transformations of acetate on its path to  $\beta$ -methylcrotonate and thence to rubber. It has been found that in the enzymatic system represented by the contents of plant cells, acetate is not further metabolizable until it is first transformed to the derivative acetyl-coA (8). The facts available suggest that the path of acetyl-coA to  $\beta$ -methylcrotonate may follow this general outline:



In this pathway, acetyl-coA is joined with itself to form a 4-carbon compound acetoacetyl-coA, which is then hydrolyzed to acetoacetate. Another acetyl-coA molecule is joined to acetoacetate to form a 6-carbon compound, and carbon dioxide and water are subsequently cleaved from this material to form  $\beta$ -methylcrotonyl coA.

$\beta$ -Hydroxy- $\beta$ -methylglutarate (BOG) was first suspected as an intermediate in this series of reactions when it was tentatively identified as a product of the metabolism of  $C^{14}$ -labeled acetate by an acetone powder of spinach leaves (9). BOG is now known to be a naturally occurring plant product (10, 11) and its metabolism in the plant has been elucidated by J. A. Johnston and D. Raussen. The sequence of reactions 1 through 4 can be consummated with an enzyme system prepared from flax seedlings, a plant that normally accumulates considerable quantities of BOG. Reactions 1, 2, and 3 have been studied in several systems (12-14) including those of plants (8) and are common to the fatty acid metabolism as well as to isoprenoid syn-

thesis. Reactions 4 and 5 have been investigated conveniently in the reverse direction, using labeled  $\beta$ -methylcrotonate and  $\text{CO}_2$  as the substrates.

It is now of interest to know how  $\beta$ -methylcrotonyl units are polymerized and whether it is the  $\beta$ -methylcrotonyl-coA derivative that is involved in rubber formation. It appears possible that union of 5-carbon units is carried on in a manner basically similar to that by which the 2-carbon acetyl-coA fragments are united to form the 4-carbon acetoacetyl-coA. Reduction of the 10-carbon compound, which would result from the initial polymerization, would lead then to a 10-carbon hydrocarbon. But this union necessarily involves several individual enzymatic steps. It involves the introduction of the specificity of the *cis*-bond in each of the two 5-carbon units. We do not yet understand how the responsible enzyme catalyst assures that each unit as it is introduced into the whole will be of the *cis*-configuration, but we do at least have an effective and readily studied system for the working out of these important matters.

It is interesting to note that the pathway by which plants make rubber is not unique to plants but has its parallel in microorganisms and in animal tissues. The participation of acetate and of  $\beta$ -methylcrotonyl units in the syntheses of carotenoid pigments by a variety of lower organisms appears probable (15). In these lower organisms, however, as in most higher plants, polymerization of the monomer stops when 8 units are put together. This 8-unit piece is then modified by the introduction of further double bonds until a carotenoid pigment is formed.

The steroid cholesterol appears to be synthesized from acetate in the animal body as is rubber in the plant (16). All carbon atoms of cholesterol derive from acetate. Both  $\beta$ -methylcrotonate and the 6-carbon,  $\beta$ -hydroxy,  $\beta$ -methylglutarate are indicated as intermediates in this synthesis (16, 17). That the synthesis of  $\beta$ -methylcrotonate by liver proceeds from acetate through  $\beta$ -OH,  $\beta$ -methylglutarate as outlined in reactions 1-5 has been indicated by recent work (18-21). It appears possible from the work of Bloch (16) that the animal may first synthesize a linear triterpene containing 6 of the 5-carbon monomer units

and then cyclize this triterpene to form a precursor of cholesterol which is then modified by elimination of appropriate carbon atoms to form the final carbon skeletal of the substance.

**Summary.** The problem of how rubber is synthesized in the plant has been divided into two portions: (i) the nature of the monomer used and how this monomer is synthesized, and (ii) the nature of the polymerization reaction by which the monomer is transformed to rubber. With respect to the first, the monomer appears to be the 5-carbon branched-chain compound  $\beta$ -methylcrotonic acid or a derivative thereof. This substance is synthesized in the plant from acetyl-coA. With respect to the second, no information is available, since polymerization of the 5-carbon monomer units to polymers has not yet been achieved outside the living plant.

#### References and Notes

- \* Presented at Joint Elastomer Conference, Department of Defense, 12-13 Jan. 1954.
1. Memorandum, Office of Chief of Ordnance, 3 Aug. 1953.
2. J. Bonner and A. W. Galston, *Botan. Revs.* **13**, 543 (1947).
3. J. Bonner and B. Arreguin, *Arch. Biochem.* **21**, 169 (1949).
4. B. Arreguin and J. Bonner, *ibid.* **28**, 173 (1950).
5. J. Bonner, *J. Chem. Educ.* **26**, 628 (1949).
6. B. Arreguin, J. Bonner, and B. J. Wood, *Arch. Biochem.* **31**, 234 (1951).
7. Compagnon and Tixier, *Rev. gén. caoutchouc* **27**, 525, 591, 663 (1950).
8. A. Millard and J. Bonner, *Arch. Biochem. and Biophys.* **49**, 343 (1954).
9. R. S. Bandurski, T. Coyle, and J. Bonner, *Biology 1953* (Calif. Inst. Technol., Pasadena, 1953).
10. R. Adams and B. L. Van Duren, *J. Am. Chem. Soc.* **75**, 2377 (1953).
11. H. Klosterman and F. Smith, *ibid.* **76**, 1229 (1954).
12. E. R. Stadtman, M. P. Doudoroff, and F. Lipmann, *J. Biol. Chem.* **191**, 377 (1951).
13. F. Lipmann et al., *J. Am. Chem. Soc.* **74**, 2384 (1952).
14. H. Beinert et al., *J. Biol. Chem.* **203**, 35 (1953).
15. T. W. Goodwin, W. Lajinsky, and J. S. Willmer, *Biochem. J. (London)* **53**, 208 (1953).
16. K. Bloch, *Harvey Lectures* (Academic Press, New York, 1952-53), p. 68.
17. L. C. Clark et al., *Federation Proc.* **13**, 192 (1954).
18. H. Rodney, *ibid.* **13**, 286 (1954).
19. ———, *J. Am. Chem. Soc.* **76**, 2595 (1954).
20. A. W. Robinson, B. K. Bachhawat, and M. J. Coon, *Federation Proc.* **13**, 281 (1954).
21. J. Rabinowitz and S. Gurin, *J. Biol. Chem.* **200**, 307 (1954).

## Nucleotides from $\text{T2r}^+$ Bacteriophage\*

Robert L. Sinsheimer

Physics Department, Iowa State College, Ames

**I**F desoxyribonucleic acid, obtained by osmotic shock from  $\text{T2r}^+$  bacteriophage, and deproteinized, is treated successively with pancreatic desoxyribonuclease and purified venom phosphodiesterase (1), 62 percent of the phosphorus (P) of the nucleic acid can be recovered in the form of mono-

nucleotides. This result is in distinct contrast to that obtained with calf thymus or wheat germ desoxyribonucleic acid, which are degraded quantitatively to mononucleotides by this procedure (1, 2). The remainder of the P is in the form of enzyme-resistant di-, tri-, and polynucleotides.

If the mononucleotides thus obtained are fractionated by ion-exchange chromatography at pH 4.3 (3), five peaks are obtained. The last three of these are readily recognized as thymidylic, desoxyadenylic, and desoxyguanylic acids. The first two, temporarily named H1 and H2 (Fig. 1), are new nucleotides, cystosine-like in spectra. The proportions of the five mononucleotides are given in Table 1. Data on certain ultraviolet spectroscopic ratios of the two new nucleotides are given in Table 2.

While differing in spectra at pH 4.3, nucleotides H1 and H2 are virtually identical in spectra at pH 7 or pH 1. Upon hydrolysis in 6*N* HCl for 3 hr at 100°C, both nucleotides yield the pyrimidine, 5-hydroxymethylcytosine (HMC) (4), as evidenced by its chromatographic behavior in water-ammonia-propanol solvent (5) and its ultraviolet absorption spectrum (6). One mole of HMC per mole of phosphorus is obtained from each nucleotide.

Both nucleotides are dephosphorylated by prostatic phosphomonoesterase. Both are dephosphorylated by the 5-nucleotidase of rattlesnake venom, which is known not to attack 3'-desoxyribonucleotides (7), although it should be noted that the action of this enzyme on H1 is considerably slower than on H2.

Upon applying the Stumpf (8) test for desoxyribose, both H1 and H2 produce an incomplete reaction, very nearly parallel in time course to that of desoxycytidylic acid. Upon applying the Dische test (9), H2 produces in 24 hr an absorption peak at 380 mμ, characteristic of desoxyribose; H1, however, produces an immediate reaction, characteristic of hexoses, with an absorption maximum at 410 mμ. In 24 hr the spectrum shifts to that obtained from a mixture of hexose and desoxypentose.

If H1 is hydrolyzed with 1*N* HCl for 2 hr at 100°C, 0.92 mole of reducing sugar (10) is released per mole of P. Similar treatment of H2 released no reducing sugar (under these conditions, desoxyribose is converted to levulinic acid and does not titrate as a reducing sugar).

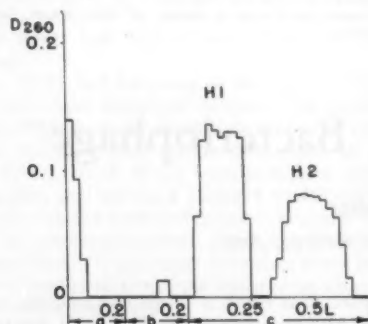


Fig. 1. Chromatographic fractionation of H1 and H2 from 60 mg of T2r<sup>+</sup> DNA. Column Dowex-1-8x, 10cm  $\times$   $\pi$ /4 cm<sup>2</sup>. a, 0.01*N* NH<sub>4</sub>OH; b, 0.01*M* acetate buffer, pH 4.3; c, 0.06*M* acetate buffer, pH 4.3.

Table 1. Mononucleotides obtained by enzymatic degradation of T2r<sup>+</sup> DNA.

Nucleotide	Ultraviolet absorption at 260 mμ (%)	P (%)
H1	1.78	3.0
H2	1.25	2.2
Thymidylic	20.0	22.2
Adenylic	34.5	22.8
Guanylic	15.9	12.5
Total	73.4	62.7

Table 2. Spectroscopic ratios.

pH	Ratio (mμ/mμ)	H1	H2	Desoxycytidylic
4.3	260/280	0.66	0.60	0.64
	270/290	1.45	1.28	1.60
6.5	260/280	0.83	0.82	1.02
	270/290	1.96	1.97	4.2

Paper chromatographic analysis of such a 2-hr hydrolysate of H1, using a water-pyridine-butanol solvent (3:4:6 parts by volume) and staining with aniline phthalate reagent (11), indicated the presence of an aldohexose that migrates as does glucose. Spraying with ninhydrin reagent gave a negative reaction.

After hydrolysis of H1 for 1 hr in 1*N* HCl at 100°C, which released 0.61 mole of reducing sugar per mole of P, the digest was fractionated on Dowex-1 resin at pH 4.3. Three peaks were recovered, a pyrimidine base, ungraded H1 (0.10 mole/mole initial H1), and H2 (0.25 mole/mole initial H1). The pyrimidine base had the spectrum of HMC and migrated with HMC in paper chromatography. However, it gave a positive hexose reaction in the Dische test (HMC does not) to the extent of 0.27 mole hexose (as glucose) per mole initial H1. The ungraded H1 plus the hexose of the pyrimidine base thus accounts for the residual, unreleased hexose of the initial H1. The H2 recovered must have been derived from the H1 by splitting off reducing sugar (glucose).

Similar hydrolysis of H2 yielded only HMC and ungraded H2 (0.41 mole/mole initial H2).

It thus appears that H2 is 5-hydroxymethyl-desoxycytidylic acid, while H1 is a glycosyl substituted 5-hydroxymethyl-desoxycytidylic acid. The mixed pyrimidines recovered after acid hydrolysis of H1 are HMC and glycosyl substituted HMC. The position of the glucose substitution has not been established, although the 5-hydroxymethyl position seems most likely in view of the near identity of the spectra of H1 and H2.

Thymidylic, desoxyadenylic, and desoxyguanylic acids from T2r<sup>+</sup> nucleic acid give only the desoxyribose reaction in the Dische test.

It thus appears that the nucleic acid of T2r<sup>+</sup> is an example of an unusual desoxyribonucleic acid with glucose side chains.

It may be noted that the nucleotides H1 and H2 differ notably in both the sensitivity and nature of their response to irradiation with ultraviolet (2537 Å) irradiation.

#### References and Notes

- \* This work was supported by grants-in-aid from the American Cancer Society and the U.S. Public Health Service.
1. R. L. Sinsheimer and J. F. Koerner, *J. Biol. Chem.* **198**, 293 (1952).

2. R. O. Hurst, A. M. Marko, and G. C. Butler, *ibid.* **304**, 847 (1953).
3. R. L. Sinsheimer and J. F. Koerner, *Science* **114**, 42 (1951).
4. G. R. Wyatt and S. S. Cohen, *Biochem. J. (London)* **65**, 774 (1953).
5. A. D. Hershey, J. Dixon, and M. Chase, *J. Gen. Physiol.* **36**, 777 (1953).
6. We are indebted to C. S. Miller of Sharp and Dohme Division, Merck and Co., for a gift of synthetic 5-hydroxymethylcytosine.
7. A. M. Michelson and A. R. Todd, *J. Chem. Soc.* (1954), p. 84.
8. P. K. Stumpf, *J. Biol. Chem.* **169**, 367 (1947).
9. Z. Dische, *ibid.* **181**, 379 (1949).
10. J. T. Park and M. J. Johnson, *ibid.* **181**, 140 (1949).
11. L. Hough, J. K. N. Jones, and W. H. Wadman, *J. Chem. Soc.* (1950), p. 1702.

## Lewis J. Stadler, Geneticist

IN the death of Lewis J. Stadler on 12 May 1954 the science of genetics lost one of its most gifted and talented votaries. For more than 30 years Stadler conducted genetic experiments notable for their significance and clarity of conception, yet his influence on the course of genetical theory cannot be properly assayed from the published record alone. His penetrating and logical mind and his unexcelled ability to grasp the essential and discard the trivial made him a masterful critic and analyst. His friendly counsel and advice were constantly sought, for the extraordinary quality of his intellect was widely recognized. It is truly lamentable that death should come at the relatively early age of 57 when he was at the height of his intellectual powers and at a time when he was engrossed in fruitful studies.

Stadler attended the University of Missouri for 2 years before transferring to the University of Florida, where he obtained the degree of B.S. Agric. in 1917. Returning to Missouri for graduate work, he was awarded his A.M. in 1918 and then spent the following year at Cornell before coming back to Missouri to finish his graduate studies in 1922. Stadler was an assistant and instructor in the Department of Field Crops during the period of his graduate work, and after obtaining his Ph.D. he was made an assistant professor.

Except for a year spent at Harvard and Cornell (1925-26) as a National Research Council fellow and for sojourns as visiting professor at the California Institute of Technology in 1940 and at Yale in 1950, Stadler remained at Missouri until his death. From 1930 to 1954 he was jointly employed by the University of Missouri and the U.S. Department of Agriculture. Under Stadler's leadership the genetics laboratory at Missouri became a world-renowned center that attracted fellows from many lands.

Beginning with 1921 his maiden publications dealt with field plot technique and related agronomic problems, and it was not until 1925 that his first genetical paper, a study of variation in linkage values in maize, appeared. A more extensive analysis of the same phenomenon was published in 1926. Even today these

papers constitute the most critical and intensive study of variation in recombination values in maize and are noteworthy contributions to genetic knowledge. However, it was at the 1927 meeting of the AAAS at Nashville that Stadler attracted wide attention by his confirmation of Muller's (1927) prior announcement of the mutagenic effect of x-rays. As is so often true, the same type of experimentation is conducted coincidentally and wholly independently in more than one laboratory; this was true for the genetic effects induced by x-rays. It in no way detracts from the significance of Muller's work to say that Stadler was also a pioneer investigator of the genetic effects of short-wave irradiation.

From 1926 on Stadler was primarily concerned with studies of gene mutation, and it is with this area of genetic research that his name is commonly associated. The critical nature of Stadler's mind is best revealed by his approach to the nature of induced mutation. Immediately following the disclosure that x-rays produced gene mutations it was widely held that induced mutations were similar to those occurring spontaneously and that at last the geneticist had a powerful technique that would eventually lead to a solution of the nature of the gene. Stadler was one of the few, and the foremost among these, who felt that a comparative study of spontaneous and induced mutations was essential in order to evaluate the usefulness of this new tool in the determination of gene structure. He therefore began a long and extensive series of experiments in which he compared spontaneous and induced mutation at selected loci in maize. These brilliantly planned and executed investigations led him to conclude that in maize, at least, all x-ray induced mutations were extragenic in origin and that x-rays did not produce the kind of germinal changes arising spontaneously. Some geneticists are loath to believe that Stadler's conclusions apply to all forms of organic life, but no one can question the ineluctable force of his closely reasoned arguments. In Stadler's studies on the mutational process, we have an example of scientific experimentation at its best. They are superb in their clarity of conception and design, in

their singularity of purpose, and in their dispassioned and logical analysis. Younger geneticists could study them with profit.

Stadler was not a prolific writer; his publications number only 64. He published only when he felt he had something important to say and was not interested in accumulating a long bibliography. Perhaps his standards were too high in this respect, because it is regrettably true that a great deal of significant work remains unpublished. It is a fortunate circumstance that he often included conclusions from unpublished studies in his numerous symposium papers, and for this reason these publications are among his most valuable contributions. It is here that the extent and comprehensiveness of Stadler's mutation studies are most evident, and much of his influence on genetic thought stems from his participation in symposiums. A lucid and persuasive speaker, he was in demand as a lecturer and spoke before many scientific groups.

Although unquestionably an outstanding authority in his field, Stadler was not one of those specialists with little or no appreciation of other intellectual pursuits. On the contrary, he was a man of culture and wide interests, one whose conversations revealed a

broad and tolerant mind. He accepted the critical and unyielding nature of his illness courageously and philosophically. I had the good fortune to visit briefly with him just as he was leaving for the hospital to undergo the operation from which he never recovered consciousness. Never once did he touch on his physical condition, of which he was well aware, but with his usual contagious enthusiasm outlined proposed experiments for the attack on the nature of the gene. With a calm fortitude he was prepared to face the inevitable.

Needless to say, many honors came to Stadler. He was a member of the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences, as well as a host of others. Among the elective offices he held were president of the Genetics Society of America and national president of the Society of Sigma Xi. But more important than these kudos is the respect and admiration held for him by his fellow-scientists. A great and wise colleague has gone; science has lost a truly eminent man who spoke in a clear and authoritative voice.

M. M. RHOADES

Department of Botany,  
University of Illinois, Urbana

## News and Notes

### Friends of Pleistocene Geology— 17th Reunion

The 17th reunion of the Friends of Pleistocene Geology was held in Wellsboro, Pa., on 22-23 May. About 100 persons attended, coming from Ontario, Maine, Michigan, Maryland, and intermediate points. In addition to Pleistocene geologists, the group included soil scientists, foresters, botanists, and archeologists. A field excursion in connection with the reunion was conducted jointly by W. H. Lyford, soil scientist with the Soil Conservation Service, U.S. Department of Agriculture, and the writer. We are carrying on a collaborative field study of the soils and the Wisconsin and pre-Wisconsin drifts in an area that extends roughly north from the latitude of Williamsport, Pa., to that of Ithaca, N.Y., and west from the longitude of Binghamton, N.Y., to that of Wellsboro.

The field excursion was devoted to three major problems. The first was a study of the lithology, stratigraphy, and topographic expression of early Wisconsin drifts, the "Olean" and "Binghamton" drifts of local usage [P. MacClintock and E. T. Apfel, *Bull. Geol. Soc. Amer.* 55, 1143 (1944)]. The second objective was an examination of the soils developed on these deposits. And finally, the excursion attempted to demonstrate that the "Olean" and "Binghamton" drifts have been modified by periglacial processes, chiefly mass movements, and that such modification took place in large part prior to the retreat of a "post-Binghamton" ice sheet, the "Valley Heads" of local usage [H. L. Fair-

child, *Bull. Geol. Soc. Amer.* 43, 627 (1932)]. A tentative correlation of these drifts with the drifts of central United States is as follows:

Local name	Possible correlative in central United States
"Valley Heads" drift	Cary substage
"Binghamton" drift	Tazewell substage
"Olean" drift	Iowan and/or Tazewell substages

C. S. DENNY

U.S. Geological Survey, Washington 25, D.C.

### U.S. Geological Survey's Paleontology and Stratigraphy Branch

The current program of the U.S. Geological Survey's Paleontology and Stratigraphy Branch was reviewed by its scientific staff during 3 days of meetings at the U.S. National Museum in Washington, D.C., 19-21 Apr. The purpose of these meetings was to outline and appraise the program in terms of individual project objectives, research methods, and progress. More than 40 speakers from the branch's three laboratory centers described their work in the course of five sessions. Nine visiting observers attended the meetings and led the discussion in a sixth and final appraisal session. Colleagues from the Washington area responded to a general invitation to attend. Many unscheduled conferences grew out of the scheduled but informal meetings.

The first session reviewed progress with paleotec-

tonic map and geologic lexicon compilation. Work on Jurassic paleotectonic maps has progressed to the point of final drafting and has revealed facies and thickness trends of substantial interpretive and economic interest. Additional maps are planned that will eventually cover the entire geologic column for the United States. Laboratory sedimentation studies and supplementary field investigations are being undertaken in connection with the paleotectonic map work. The preparation of a check list of new geologic names and usages in North America since 1935 is also well advanced. It is intended to follow this with the preparation of supplements to the Survey's *Lexicon of Geologic Names of the United States*, which will eventually bring the record up to date in the same degree of detail that was provided in the original work by Wilmarth.

Discussion of other phases of the branch's work was organized in terms of principal functional units, although most activities somewhere overlap the intentionally flexible unit boundaries. Members of the lower Paleozoic unit are preparing monographic syntheses on trilobites, ostracods, and bryozoans, and they are conducting stratigraphic and paleoecologic studies of lower Paleozoic rocks of New England, the Great Basin and Pacific Coast, and the subsurface of the Williston basin. The staff of the upper Paleozoic unit is working on summary studies of the ranges and relationships of corals, bryozoans, gastropods, ostracods, conodonts, cephalopods, and fusulinids. They are also investigating stratigraphic and paleoecologic problems in the upper Paleozoic rocks of the mid-continent region, the Rocky Mountains, the Great Basin, Alaska, and the subsurface of the Williston basin.

Paleontologists of the Mesozoic unit are concentrating on the molluscan faunas and stratigraphy of the Mesozoic rocks of the western interior and Alaska, the Triassic faunas and stratigraphy of Nevada and California, the Cretaceous faunas and stratigraphy of the Gulf Coast, and a critical summation of the North American *Orbitolinas*. The Cenozoic staff is concerned with studies of mollusks, echinoderms, and Foraminifera of the coastal parts of the United States and the Caribbean region, and with the stratigraphy and paleontology of the insular western Pacific. Current studies of vertebrate paleontology and paleobotany are mainly concerned with the morphology, paleoecology, and stratigraphic ranges of Cenozoic mammals of the Rocky Mountain region and the Mojave Desert, late Paleozoic floras of the mid-continent region, Tertiary floras and diatoms of the western United States, and algae through time. It is hoped soon to initiate research on pollen and spores, wood, and nonmarine mollusks.

A prominent part of the branch program involves the study of material referred for examination by other units of the Geological Survey. Although the primary aim of this work is to answer specific questions formulated by others, it is also a fruitful source of material and ideas leading to new basic studies and discoveries. Collaborative work is not restricted to

Survey units—current biogeochemical investigations involve the collaboration of five non-Federal institutions, and studies of a new Tertiary nonmarine arthropod fauna have called on the talents of a wide selection of entomologists and an arachnologist.

The research that keeps the staff of the branch prepared to meet a variety of calls for special aid or collaborative investigations is aimed toward supplementing continued advance along conventional fronts with development of new fields and approaches. It is of four principal types: (i) monographic studies of the structure, biologic organization, life associations, and ranges in time of large or significant groups of fossils; (ii) stratigraphic and paleoecologic investigations of particular rock sequences, community associations, or areas, including comparisons with areas or fields beyond immediate fields of study; (iii) continuing morphologic and stratigraphic analyses of inadequately known but potentially important groups of organisms, such as the air-borne and planktonic forms that may attain wide distribution in brief time intervals, cross facies boundaries, and be well-adapted to quantitative methods of analysis; and (iv) studies leading to the preparation of regional field handbooks that will present selected suites of distinctive fossils in stratigraphic context. Critical evaluation of analytic procedures and methods of presentation of data and conclusions is encouraged in connection with efforts toward the objectives mentioned, but not as an end in itself.

At the conclusion of the sessions, invited critics expressed the hope that more monographic syntheses would be forthcoming as recessed and new work gathered momentum. The great diversity of activity drew special comment. It is anticipated that the published results of work in progress will demonstrate that this diversity reflects a coming to grips with varied and basic problems.

PRESTON E. CLOUD, JR.  
U.S. Geological Survey, Washington 25, D.C.

## Science News

In a two-part article on "U.S. Science: The Troubled Quest" in the *Reporter* magazine for 14 and 23 Sept., Theodore H. White, after illustrating the importance of government money to scientific research and saying that American scientists are disturbed by some of the political aspects of government contributions, outlines the background that men must consider if they wish to understand the reasons scientists are disturbed.

First, there is the background of science itself, the quest for pure knowledge in whose long trail they [the scientists] find themselves at the moment in a jungle of preposterous puzzles. Second, there is the background of America's curious scientific community, so different and so changed from its own past and from any other in the world.

In considering the first aspect of the background, the author describes in general terms the "puzzles"

faced by physicists and biologists, and notes the high cost of investigation. As for the second aspect, he discusses the changed nature of American science (from penury to abundance) and presents some details about the decline of science instruction in the schools from which future scientists must come.

In the second part of this article White describes how the bringing of scientists into national defense questions, not merely as weapons technologists, but as developers of a new system, has brought about the political and security problems that now disturb them.

The wide and effective application of **growth regulators** during the past decade, particularly in the field of chemical weed control, has stimulated the interests of plant physiologists and biochemists in the fundamental mechanism of growth regulation. Although a number of chemicals act as growth regulators, 2,4-dichlorophenoxyacetic acid (2,4-D) is by far the most effective. Several responses of plants comparable to those produced by 2,4-D are induced by the naturally occurring hormone or auxin, indoleacetic acid (IAA). The effects of these two substances on oat and sunflower tissues are discussed by J. H. M. Henderson, I. H. Miller, and D. C. Deese in a paper scheduled for a forthcoming issue of *Science*.

A method used by the ancient Romans to **purify water**, that of dropping bars of silver into aqueducts, may be adopted by American industries to sterilize water. A Pittsburgh company carried out tests of purification processes based on the use of silver salts. Harmful bacteria are speedily killed by "bullets" of silver released into the water by the new method called the hyla process. Water purified by this process is not only free from bacteria but also it has no taste or smell. The process has gained wide acceptance in Europe, and the United States Public Health Service says water with less than one part of silver to a million parts of water is safe. Tests at Johns Hopkins University proved that hyla-treated water had only seven to a billion parts of silver.

The total **synthesis of strychnine** is reported in the 20 Sept. issue of the *Journal of the American Chemical Society* by a team of Harvard University chemists led by R. B. Woodward, Morris Loeb professor of chemistry. Working with Woodward were Michael Cava, A. Hunger, W. D. Ollis, H. U. Daeniker, and K. Schenker, all of whom were or are postdoctoral fellows in the Converse Memorial Laboratory.

Since the medical demand for strychnine is easily met from the natural product, the discovery has no practical value, but it contributes to man's understanding of natural processes. One of the first alkaloid substances to be isolated in pure state (by Pelletier and Caventou in 1818), strychnine has long presented a challenging problem to chemists. It is one of the most complicated of the ordinary-sized molecules occurring in nature, and its synthesis is a more involved one than Woodward's earlier achievements

with quinine and cortisone. The strychnine molecule is an intricate web of 21 carbon atoms, 22 hydrogen atoms, and 2 each of nitrogen and oxygen. The process that led to the reconstruction of the molecule was completed in 3 yr; 1 yr was devoted to preliminary studies and 2 yr to detailed laboratory work. The synthesis as completed takes 30 laboratory steps.

The World Health Organization has taken the opportunity offered by the 10th anniversary of the advent of penicillin therapy and the centenary of Paul Ehrlich, discoverer of chemotherapy, to review the development of **syphilis treatment methods**. A recent issue of the *Bulletin of the World Health Organization* is devoted exclusively to the study of this question. Although syphilis has become much less serious in some countries in the last decade, it continues to be an important public health problem in many others. WHO, in fact, estimates that there are about 20 million syphilitics in the world today and that in some special areas in certain countries up to 80 percent of the population may be afflicted.

Penicillin is considered a fully effective, nontoxic and relatively inexpensive remedy; a single injection will cure a patient in from 10 to 15 days at a cost of between 93 ct and \$1.40. WHO's appraisal of treatment practices, carried out in 55 countries 10 yr after the initiation of the use of penicillin, shows the extent to which penicillin therapy has replaced the classic metal chemotherapy (bismuth, arsenic, mercury). A total of 65.3 percent of the clinics covered by the survey use penicillin without adjuvant therapy; 28.9 percent use penicillin combined with other drugs, and 5.8 percent use metal chemotherapy without penicillin. All the North-American clinics and 52.2 percent of the European ones use penicillin alone.

An article by Niels C. Beck in *Frontier*, a publication of the Armour Research Foundation of Illinois Institute of Technology, comments on the tendency of people to seek obscure reasons for purely natural phenomena. The following extract regarding the recent **pitted windshield epidemic** was included.

... During the pitted windshield epidemic, Foundation scientists examined about 25 samples of shattered and pitted windshields submitted for analysis by Chicago area motorists.

The marks in nearly every case were found to be similar and several months old. . . . "There was no evidence that the damage resulted from radio-activity, cosmic rays, or air rifles. Gravel, dirt, or stones probably thrown up by other cars accounted for the damage in all cases," they said.

The second issue in June of *Naturwissenschaften* (41, 269) carries an article on **nuclear reactors** by K. Wirtz of Göttingen that considers the legal, economic, and technical situations to be met in West Germany after other nations have already developed atomic fuel. West Germany is allowed to construct a reactor with 1500 kw maximum power, or to design several reactors with a total power of 1500 kw. No more than

500 g/yr of plutonium may be produced. The western sector has the right either to produce or to import 30 tons of uranium if the reactor should actually require this amount; then, in the following years, nine tons per year can be used. Eighteen tons of uranium may be stored. West Germany has two uranium deposits but no particularly rich ore, the average concentration being 0.2 percent. As far as is known now, West Germany does not have enough uranium deposits to develop the uranium or nuclear reactor industries independently—that is, without importing.

After this brief introduction to the problems of developing nuclear reactors in Germany, the article discusses various reactors in some detail. There is an excellent summary (in tables and graphs) of the properties of nuclear reactors as far as they are known to the public. This paper will be quite useful for the teacher who wants to introduce senior and beginning graduate students to nuclear technology.

Wirtz also discussed reactors and their future as power sources in Germany at the 84th annual meeting of the Society of German Engineers (V.D.I.) in Mannheim [*Physikalische Blätter* 10, 324 (1954)].—K. L. H.

On 15 Sept. the Army confirmed the reinstatement of Allan G. Weisner of Asbury Park, N.J., who was suspended for security reasons from the radar center at Fort Monmouth, N.J. Weisner is the eighth of the 22 suspended workers to be reinstated. Four have been dismissed and the other 10 cases are awaiting final decisions.

One of the significant papers presented at the heart-surgery session of the recent World Congress of Cardiology was that of James P. Grace describing **bloodless heart operations** on dogs during cessation of heart-beat and breathing at low body temperature—below 10°C. Grace heads a four-man team at Nashville, Tenn., that performed this operation on 13 dogs, all of which survived the operations though four died of postoperative complications. During the operation circulation outside the heart was maintained by shunting the blood through a simple apparatus that both supplied it with oxygen and cooled it. After about 30 min of heart stoppage, rewarming the blood restored normal heart and lung functions. Heart-beat began again at 15.1°C.

Arnold H. Sparrow and Lloyd A. Schairer of the Brookhaven National Laboratory, Upton, N.Y., have reported the first positive proof that atomic radiation can cause **tumors in plants**. Scientists have known for several years that atomic rays or particles, as well as x-rays, can cause tumors in human beings and they have suspected that this was also true for plant life.

Sparrow and Schairer exposed tobacco plants to gamma rays given off by cobalt-60. This particular type of tobacco plant normally produces nonfatal tumors as it grows. However, when bombarded by atomic rays the plants became covered with a green-

gray tumor mass, withered, and died within a few weeks. The continued study of the effects of atomic radiation on plant cells may provide information about all cancerous growths.

The Soviet Union announced on 17 Sept. that it had exploded another atomic weapon. The Government newspaper *Izvestia* said: "In accordance with the plan of scientific research work, trials of one of a type of atomic weapons were carried out. . . . The trials produced valuable results, which will enable Soviet scientists and engineers to solve successfully problems of defense from atomic attack." In August the Russians conducted tests involving both fission and thermonuclear explosions.

**Damage to 35 mm negatives** from scratches, dust, or fingerprints can now be corrected by using a newly developed liquid in a specially devised film holder, or carrier, attached to the photographic enlarger. The discovery and invention stem from experiments by C. Guy Suits, vice president of General Electric Co. and director of research. Commercial production problems are being solved, and both film-holder (Refractamat 35, designed by Simmon Bros., Inc., Long Island City, N.Y.) and the liquid (Refractasil, a product of the G.E. silicone products department at Waterford, N.Y.) are expected to be on the market in a few months.

In view of a recent federal court order in Maine regarding the Wilhelm Reich Foundation and its claims for **orgone treatment**, a summary of Reich's activities may be of interest.

Wilhelm Reich's early work in psychoanalysis in Austria and Germany was generally accepted by psychoanalysts as an important contribution. His collected papers on character formation, published in book form in 1933, were considered a pioneer clinical study of both ego psychology and the techniques of character analysis. But Reich's concepts seemed to change suddenly. In his paper read at the International Psychoanalytic Congress in 1934 he described character as biophysical behavior, to which he applied his orgasm theory. That same year, according to the translator's preface to the second edition of *Character Analysis*, Reich was excluded from the International Psychoanalytic Association, allegedly because "he had become too well known as an anti-fascist."

He went to Norway, where he claimed discovery between 1936 and 1939 of "a visible . . . ubiquitous cosmic energy," and began to publish a magazine on sexual economics. About 1940 he came to this country.

The Wilhelm Reich Foundation was established at Orgonon, Rangeley, Maine. Here Reich concentrated on "Orgone biophysics and . . . orgone therapy." The orgone energy accumulator, equipped with shooter, was made, which was represented to collect, accumulate, and use 'Life Energy . . . for scientific, educational and medical purposes.' As pictured, the device looks like a telephone booth. An orgone energy blanket was made for bed patients. Use of either device was claimed to greatly benefit the patient with various diseases, from cancer, brain tumor, and severe sexual stasis, to colds or hay fever.

Although supposedly self-regulating, treatment and its results could be judged only by use of Reich blood tests and by "authorities in the field of orgonomy." Individuals were allowed to use the device in their own homes by contributing a monthly fee "to the Orgone Research Fund." For some time leading psychiatrists in this country have felt that evidence brought forward in favor of the so-called orgone theory is unconvincing, and that orgone treatment is scientifically unsound.

By a decree of injunction . . . the defendants [the foundation, Wilhelm Reich, and Ilse Ollendorff] and all their associates were "perpetually enjoined and restrained from doing any of the following acts, directly or indirectly," in violating certain sections of the Act, "with respect to any orgone energy accumulator device, in any style or model, any and all accessories . . . purported and represented to collect and accumulate the alleged orgone energy."

The decree further ordered the defendants to recall all such devices shipped on a rental or similar basis in interstate commerce and to destroy or dismantle them; to withhold all publications describing these devices or their use or to delete all such passages; to destroy all printed or written instructions regarding the devices and their use; to stop further dissemination of all this material; and to permit employees of the Food and Drug Administration to have access to pertinent files and records and to interview officers or employees of any defendant.

## Scientists in the News

**P. A. M. Dirac**, Lucasian professor of mathematics at Cambridge University, England, and 1933 Nobel prize winner in physics, has been granted a visa to visit the United States. Last May his application for entry to this country to spend the academic year at the Institute for Advanced Study, Princeton, N.J., was denied [*Science* 119, 829 (11 June)], although he had previously visited the institute a number of times. Dirac is one of seven well-known physicists with whom the institute has made arrangements for a continuing or recurrent association. He is expected to arrive in Princeton next April. During his trip he will also visit Canada, Japan, and India.

Another physicist who has had difficulties entering the United States, but who has now been granted special permission to visit, is the atomic scientist **M. L. E. Oliphant**, professor of physics at Australia's National University, Canberra. Oliphant has cancelled his proposed trip, however, and is not expected to take advantage of his transit permit. In 1951, administrative delays in passing on his visa application prevented Oliphant from attending an international conference of nuclear scientists in Chicago. At least 50 foreign scientists, including Nobel prize winners in fields other than physics, have been refused visas in the last 2 yr.

**Karl Bowman**, professor of psychiatry in the University of California School of Medicine, San Francisco, and supervisor of the Langley Porter Clinic, leaves in October for Manila where he will set up a program in psychiatry in the Medical School of the

University of the Philippines. During a stay of nearly 6 mo, Bowman will serve as a visiting professor. He will select one of two Filipino doctors to be sent to the School of Medicine in San Francisco for training in psychiatry. These doctors will then carry on the program Bowman establishes.

Before returning to the U.S., Bowman will spend some time at the University of Indonesia in Djakarta. There he will also advise on a psychiatry program and select men for training in California. Bowman's mission is being supported by the China Medical Board, an agency of the Rockefeller Foundation.

**Sir Alexander Fleming**, the 73-year-old discoverer of penicillin, has announced that he will relinquish his administrative duties as chief of the Wright-Fleming Institute of Microbiology on 31 Dec. to give his full time to research.

**Merril Eisenbud**, a member of the Atomic Energy Commission's New York Operations Office staff since 1947 and director of the office's health and safety laboratory since 1949, has been appointed manager of the New York Operations Office. He will continue as associate professor of industrial medicine in the Post-Graduate School of Medicine at New York University.

**Robert S. Woodworth**, professor emeritus at Columbia University, who for half a century has been one of the leading figures in American psychology, was honored recently by 160 professional colleagues at an advance celebration of his 85th birthday. Although he retired in 1942, Woodworth still teaches a course in dynamic psychology, which deals with the causes of human behavior, a field in which he is regarded as a pioneer. He is also working on another book on the same subject.

The following scientists were honored at the 126th national meeting of the American Chemical Society.

**Paul Delahay** of Louisiana State University, ACS award in pure chemistry. Delahay is recognized internationally as one of the outstanding men in electrochemistry and has made substantial contributions to polarography.

**Henry Taube** of the University of Chicago, ACS award for nuclear applications in chemistry. Taube is the first recipient of this award, which is sponsored by the Nuclear Instrument and Chemical Corp. The award is based on his investigations of oxidation-reduction and substitution reactions in aqueous solutions.

**R. Bowling Barnes** of Olympic Development Co., Beckman award in chemical instrumentation. Barnes was honored for his pioneering work in applications of infrared spectrometry; he was the first to utilize infrared spectroscopy in the qualitative and quantitative analysis of organic molecules.

**Fred Hillig** of the U.S. Food and Drug Administration, Borden award in the chemistry of milk. Hillig was nominated for this award on the basis of his re-

search in the chemistry of milk and his identification of products of deterioration in milk.

**William F. Neuman** of the University of Rochester, Eli Lilly and Co. award in biological chemistry. Neuman has made significant studies of bone metabolism and formation.

**Ernest H. Swift** of California Institute of Technology, Fisher award in analytical chemistry. Swift is credited with development of an original system of analysis that provides a combination of qualitative and quantitative methods.

**Hans Schinz** of Federal Institute of Technology, Zurich, Switzerland, Fritzsche award. Schinz was selected because of his outstanding work in the chemistry of essential oils and aromatics. He has added extensively both to the scientific literature and the literature of the perfumery field.

**Grace Medes** of Lankenau Hospital Research Institute, Garvan medal. Medes is noted for her contributions to various phases of physiological chemistry.

**John W. Williams** of the University of Wisconsin, the Kendall Co. award in colloid chemistry. Williams was first among those who applied techniques of physical chemistry and dipole moments to solving problems of colloid chemistry.

**Paul D. Boyer** of the University of Minnesota, Paul-Lewis Laboratories award in enzyme chemistry. Boyer has concentrated on problems of oxidation-reduction of biologically important compounds and on enzyme chemistry, particularly the mechanism of enzyme reactions.

**Frank G. Ciapetta** of Socony-Vacuum Oil Co., Precision Scientific Co. award in petroleum chemistry. Ciapetta is noted for his investigations in development of new processes for production of motor and aviation gasoline.

**Gerrit Van Zyl** of Hope College, Scientific Apparatus Makers award in chemical education for 1955. Van Zyl is credited with the undergraduate training of 68 students who later became Ph.D.'s, out of 198 chemistry majors.

Two new research associates have joined the staff of the General Electric Research Laboratory, Schenectady, N.Y. They are **Jack Kwiatek**, formerly a research chemist for the M. W. Kellogg Co., and **R. L. Kyhl**, a specialist in microwave spectroscopy, microwave circuits, and particle acceleration who has been engaged in research at Stanford University.

**A. Langseth**, head of the chemistry department, University of Copenhagen, is visiting the division of physics spectroscopy laboratory of the National Research Council of Canada for several months. He is well known for his work in Raman spectroscopy.

**Jean-Claude and Charlotte Pecker**, French astrophysicists who have spent the past year on the staff of the High Altitude Observatory at Boulder, Colo., have just returned to France where Dr. Pecker will teach and carry on research at Clermont-Ferrand Uni-

versity. During the year here, he studied the origin of corpuscular streams from the sun, the temperature-height distribution of temperature and pressures in the chromosphere, and the dynamics of prominence motions. Mrs. Pecker worked on the identification of the yellow coronal emission line. Her work suggests that the atomic weight of the responsible atom is about 40. **Gerard Wlérick** of the Paris Observatory will join the High Altitude Observatory staff in November for a year's stay.

At the recent International Mathematics Congress in Amsterdam a French mathematician, **Jean-Pierre Serré**, and a Japanese professor who is a member of Princeton University's department of mathematics, **Kunihiko Kodaira** of Toyko, received the Field medal. The award is one of the highest in mathematics and carries with it a \$1500 prize.

A student loan fund exclusively for needy doctoral candidates in zoology is being established at the University of Illinois in honor of the late **Prof. Harley J. Van Cleave**, eminent zoologist and member of the faculty from 1911 until his death in 1953.

**Herbert Q. Smith** has joined the staff of the research department of Reed and Carnrick, Jersey City, N.J., where he will work on the syntheses of new chemotherapeutic substances. Smith has previously conducted research at the Schering Corp. and at Lemke Co.

**Willard R. Cooke**, professor of obstetrics and gynecology and chairman of the department at the University of Texas Medical Branch, Galveston, since 1924, has asked to be relieved of administrative responsibilities so that he may devote himself fully to teaching, research, and hospital practice. He plans special work in the gynecologic aspects of cancer. **Garth L. Jarvis** will be chairman of the department.

The Office of International Relations, National Academy of Sciences-National Research Council, has provided the following information concerning the travel plans of **scientific visitors** to the United States.

**J. C. Batten**, Medical Research Council, 38 Old Queen St., London. Here for 1 yr beginning 5 Oct. on the Medical Research Council's Dorothy Temple Cross traveling fellowship. Will work under Walsh McDermott in the department of medicine at Cornell Medical Center, New York.

**Louis Houpert**, director, Dental School, Nancy France. Arrived 17 Sept. for 90 days.

**Shawkat Kanawati**, dean, School of Medicine; vice president, Syrian University, Damascus, Syria. Arrived 10 Sept. for 90 days.

**Heinrich G. Kipp**, adviser on scientific matters, Federal Ministry of the Interior, Bonn, Germany. Arrived 10 Sept. for 60 days.

**R. H. Kirby**, Colonial Products Laboratory, London. Will be in North America 7-10 Nov.

F. Mandl, U.K. Atomic Energy Authority, London. Arrived in September for 1 yr at the University of Rochester.

R. N. Parkins, department of metallurgy, University of Durham, England. Arrived late September to attend Electrochemical Society symposium on stress-cracking phenomena in Boston, 3-7 Oct. Plans to visit various laboratories and to give lectures.

J. T. Randall, honorary director, Medical Research Council Biophysics Research Unit, London. Here 8 Oct.-10 Nov. to attend the Eli Lilly conference on connective tissues in Indianapolis and to make a few visits.

Eckart Seemann, chief, City Health Department, Kempen, Germany. Arrived 17 Sept. for 60 days.

K. Tansley (Mrs. Lythgoe), Medical Research Council, London. Here 9 Sept.-13 Oct. to attend the International Congress of Ophthalmology in Montreal and New York.

Hans-Joachim von Brandis, chief surgeon, Städt. City Hospital, Germany. Arrived 10 Sept. for 60 days.

The following appointments to assistant professor have been announced. Stanford University: **Stanley Davis**, engineering geology; **A. Joe Scull**, pediatrics. Moravian College: **Albert E. H. Gaumer**, biology. University of Oklahoma: **Duane H. D. Roller**, history of science and technology.

## Meetings

Scientific methods to detect mixing of cheap fats and oils with butter fat will be a major consideration at the 68th annual meeting of the **Association of Official Agricultural Chemists** which will be held at the Shoreham Hotel in Washington, D.C., 11-13 Oct. The A.O.A.C. is the scientific organization that tests laboratory methods used to determine the purity and the safety of foods, drugs, and cosmetics, as well as fertilizers, feeds, and insecticides. The methods of analysis published by the organization are used by officials charged with the enforcement of laws regulating these products. All the sessions are open to interested scientific workers and the public. Detailed information can be obtained by writing to the association, Box 540, Benjamin Franklin Station, Washington 4, D.C.

The 7th annual **Conference on Electrical Techniques in Medicine and Biology** will be held at the Morrison Hotel in Chicago, 10-12 Nov. under the sponsorship of the American Institute of Electrical Engineers, the Institute of Radio Engineers, and the Instrument Society of America. Three sessions devoted to technical papers are scheduled; one on "Circulation and cardiology," one on "Electrical properties of biological materials," and one on "X-rays and instrumentation." At a dinner meeting the guest speaker will be T. E. Allibone, director of research of the Associated Electrical Industries of Great Britain.

Two laboratory field trips have been arranged, to

the Argonne Cancer Research Hospital and to the Argonne National Laboratory. Citizens of countries other than the United States must give 3 wk notice through the conference chairman so that admission to the Argonne National Laboratory may be arranged. The chairman is E. D. Trout, 4855 Electric Ave., Milwaukee 1, Wis.

The **American College of Cardiology** will hold its third interim scientific meeting at the Hotel Algiers, Miami Beach, Fla., 11-13 Nov. The meeting will be devoted entirely to a symposium on diet in heart disease made up of four scientific sessions, which will be in the form of panel meetings and round table conferences. Further information may be obtained from the secretary of the college, Dr. Philip Reichert, 140 W. 57 St., New York 19.

The 8th annual midwestern meeting of the **Society of Exploration Geophysicists** will be held 18-19 Nov. at the Adolphus Hotel in Dallas. R. C. Dunlap, Jr., general chairman, has announced that registration will begin 17 Nov. for more than 1000 exploration scientists from Texas, Louisiana, Oklahoma, and New Mexico.

The **National Science Foundation** will award individual grants to defray partial travel expenses for a limited number of scientists who will attend the **International Symposium of the Biometric Society** to be held at Campinas, near São Paulo, Brazil, 4-8 July 1955, or the 29th session of the **International Statistical Institute** to be held in Rio de Janeiro, Brazil, 24 June-2 July 1955. Application blanks may be obtained from the National Science Foundation, Washington 25, D.C. *Completed forms must be submitted by 31 Dec.*

For the first time anywhere, practical aspects of efficiency and cost, along with specific details on installations of many types of air pollution control devices, will be presented at the semiannual technical conference of the **National Air Pollution Control Association** scheduled for 4-6 Nov. in Los Angeles. Industry-wide reports on control of air contaminants, using existing installations as illustrations, have been programmed. Advance registration should be made through Edward S. Feldman, 2155 E. 7 St., Los Angeles 23, Calif.

The 4th annual **Conference of Western Region, National Association of Corrosion Engineers** will be held at Los Angeles, 18-19 Nov. The conference will follow a 3-day, NACE-sponsored course on the theory, surface preparation and application, testing, and preparation of specifications of protective coatings held at the University of California, Los Angeles.

Technical sessions scheduled for the conference will include marine and steel water pipe corrosion problems and the use of concrete and bituminous coatings internally and externally on water piping. J. G. Kerr, C. F. Braum & Co., 1000 S. Fremont Ave., Alhambra, Calif., is registration chairman.

A **Field Emission** symposium will take place in Pittsburgh, 10-12 Nov. Technical sessions will be held at Mellon Institute and headquarters will be at the Webster Hall Hotel. There will be four sessions on field emission proper, one session on voltage breakdown, and one on the chemistry of surfaces. Further information may be obtained from Dr. Ralph Klein, Bureau of Mines, 4800 Forbes St., Pittsburgh 13.

The **International Astronomical Union** will meet in Moscow in 1958, subject to a final decision to be made at the next general assembly of world astronomers in Dublin, 29 Aug-5 Sept. 1955. The international astronomical meeting will be held in the United States in 1961 "if the U.S. government could see its way to meet the essential requirement that all competent astronomers who are members of the International Astronomical Union would be welcome." Recently visas have not been given to some foreign scientists because of the restrictive provisions of the McCarran Act. Otto Struve, University of California astronomer, reported these decisions made at the astronomical meeting held recently in Belgium upon his return to this country.

### Available Grants and Fellowships

Three \$4000 postdoctoral fellowships in statistics are offered for 1955-56 by the University of Chicago. The purpose of these fellowships, which are open to holders of the doctor's degree or its equivalent in research accomplishment, is to acquaint established research workers in the biological, physical, and social sciences with the role of modern statistical analysis in the planning of experiments and other investigative programs, and in the analysis of empirical data. The development of the field of statistics has been so rapid that most current research falls far short of attainable standards, and these fellowships (which represent the fifth year of a 5-yr program supported by the Rockefeller Foundation) are intended to help reduce this lag by giving statistical training to scientists whose primary interests are in substantive fields rather than in statistics itself. *The closing date for applications is 15 Feb. 1955; instructions for applying may be obtained from the Committee on Statistics, University of Chicago, Chicago 37.*

The New York Academy of Medicine has announced the availability of The Louis Livingston Seaman Fund for the furtherance of research in **bacteriology and sanitary science**. A total of \$1900 will be assigned in 1954. This fund, made possible by the terms of the will of the late L. L. Seaman, is administered by a committee of the academy under the following conditions and regulations: (i) the committee will receive applications either from institutions or individuals *until 1 Dec.*, and (ii) the fund will be expended only in grants-in-aid for investigation, or scholarships for research, in bacteriology or sanitary science. The ex-

penditures may be made for securing technical help, aid in publishing original work, and purchase of necessary books or apparatus. Communications should be addressed to Dr. Wilson G. Smillie, Chairman of the Louis Livingston Seaman Fund Committee, 1300 York Ave., New York 21.

The Arctic Institute of North America, 1530 P St. NW, Washington 25, D.C., has prepared a comprehensive 25-page brochure, entitled "**Pressing Scientific Problems of the North**," to bring to the attention of North American scientists the challenge and the opportunity presented in northern research. The brochure includes the following paragraph:

Grants-in-aid for meritorious research projects are awarded yearly by the Arctic Institute. Any who have such projects in mind, or who wish to inquire about ways in which their scientific interests may find expression within the institute's program, are urged to get in touch with one of the Institute's offices. . . . In addition, Mr. Joseph T. Flakne, Director of Programming, is making contact with colleges and universities and will be visiting many of these institutions within the next few months. He will be glad to hear from anyone who would be interested in talking with him or who wishes to suggest a visit by him to a particular university. Indeed the Institute will welcome word from any who are interested in helping to further the great task it has undertaken—to accelerate and expand the scientific study of the North that we may more fully and speedily realize its economic, strategic and scientific potentialities.

The trustees of the **Melville Trust Scheme for the Care and Cure of Cancer** (Scotland) invite applications for fellowships in cancer research commencing in April 1955. The initial stipend will be according to experience, but will be not less than £800 per annum; and funds are available for the provision of equipment and for technical assistance. A fellowship is ordinarily awarded for a period of 2 yr, but may be renewed. The research is normally to be carried out in one of the recognized clinical or scientific departments in Edinburgh; and if possible applicants should have made prior contact with the head of the appropriate department; if this is not possible, the trustees will endeavor to make suitable arrangements. The research may deal with any aspect of malignant disease, and candidates need not necessarily hold a medical qualification.

Applications, together with the names of three references, *should be submitted by 31 Oct.* to the Honorary Secretary, Scientific Advisory Committee, The Melville Trust, 26 Moray Place, Edinburgh 3, from whom further particulars may be obtained. The application should be accompanied by an outline of the proposed research, and by an account of any previous scientific or research experience. The expenses incurred by any research fellow appointed from overseas in traveling to the United Kingdom will be defrayed by the Trust, which will also reimburse all candidates who are required to attend for interview.

## Grants and Fellowships Awarded

The clinical branch, Biological Sciences Division of the Office of Naval Research has awarded the following research contracts to universities and nonprofit institutions for periods of from 1 to 3 yr.

Bryn Mawr Hospital, Bryn Mawr, Pa. M. M. Strumia. Preservation and sterilization of dried blood plasma and post-transfusion hepatitis studies.

Johns Hopkins University. G. S. Mirick. Infectious hepatitis and homologous serum jaundice.

State University of New York. A. A. Siebens and K. E. Karlson. Physiology of pulmonary function following lung resection.

University of Rochester. J. U. Schlegel. Sodium retention following shock.

Yale University. M. B. Hayes. Functional endocrinologic interrelations operating in metabolic response of man to trauma.

Tufts College. O. Swenson. Neurogenic bladder.

Medical College of South Carolina. R. F. Hagerty. Survival of transplanted human, living homologous cartilage grafts.

State University of New York. E. P. Mannix. Methods for the treatment of thoracic trauma.

University of California, Los Angeles. S. M. Mellinkoff. Amino acid tolerance in liver disease.

Burke Research Co. O. W. Burke. Glycerol pectate as a plasma expander.

Duke University. N. G. Georgiade. Preservation of human skin.

Columbia University. A. H. Blakemore. Experimental evaluation of plastic textile tubes in bridging arterial defects under varying conditions.

George Washington University. B. Blades. Control of pain.

The Sister Elizabeth Kenny Foundation has announced a grant of \$90,000 to New York University-Bellevue Medical Center for the study of neuromuscular diseases, including poliomyelitis. The program will be carried out in three hospitals under the direction of Thomas I. Hoen, chairman of the department of neurosurgery, and Walter A. L. Thompson, chairman of the department of orthopedic surgery, both of N.Y.U. Post-Graduate Medical School; and Robert Ward, professor of pediatrics in N.Y.U. College of Medicine. Approximately 90 percent of the work will be done in Bellevue Hospital. Other participating hospitals will be N.Y.U.'s University Hospital and New York State's Central Islip Hospital. Under this grant, the new wards for the treatment of poliomyelitis will be supervised by Marvin A. Stevens, eastern area medical director for the Kenny Foundation, and staffed by Kenny-trained therapists.

Since 1 Jan. grants totaling \$43,100 for research and clinical studies have been made by Sharp and Dohme to hospitals, colleges, and universities.

## In the Laboratories

The engineering division of the Vitro Corp. of America is designing and engineering a biological laboratory for the Chemical Corps of the U.S. Army at Camp Detrick, Frederick, Md. The new laboratory with its related facilities and auxiliaries, including cooling tower, air incineration system, sewers, and roads, will probably cost about \$4,000,000.

A new \$150,000 dust-proof and air-conditioned control laboratory has been completed and put into operation at American Potash and Chemical Corp.'s main plant at Trona, Calif. The two-story structure, measuring 60 ft long and 40 ft wide, is an all-metal windowless building. It is to be used for the testing of chemical solutions before, during, and after their processing at the production plant. Approximately 60,000 tests are conducted per month.

Testing begins with brine pumped from beneath the surface of dry Searles Lake, source of the company's raw materials. From this brine, 21 chemicals are produced.

The Air Force has granted authority to Ohio State University's radiographic laboratory to perform x-ray radiography of materials to be used in conjunction with Air Force and Bureau of Aeronautics contracts. The laboratory has 75- and 220-kv x-ray machines, and is prepared to use cobalt-60 for radiographic inspection. In October installation of a 400-kv machine will be completed. The radiographic equipment is available for limited industrial use by arrangement with the university's Engineering Experiment Station.

A group of New England electric companies has agreed to form a corporation, to be known as the Yankee Atomic Co., for generating atomic energy. The participating companies produce about 90 percent of the electric power in the region. William Webster, executive vice president of the New England Electric System, is president of the new firm.

On 14 Sept. President Eisenhower dedicated the new radio research laboratories of the National Bureau of Standards in Boulder, Colo.

## Necrology

Ashton B. Cooper, 70, president of Ferranti Electric, Ltd., Toronto, Canada, 15 Sept.; Norman C. Fassett, 54, authority on plant life and former professor of biology at the University of Wisconsin, Madison, Wis., 14 Sept.; Thomas C. McFarland, 61, author and professor of electrical engineering at the University of California, Berkeley, Calif., 16 Sept.; Vlades Naigus, 75, archeologist and former curator of the Lithuanian National Museum, Cleveland, Ohio, 15 Sept.; Oscar W. Peterson, 63, former research chemist with E. I. du Pont de Nemours and Co., Perth Amboy, N.J., 18 Sept.; Daniel G. Revell, 86, emeritus professor of anatomy at the University of Alberta, Edmonton, Alberta, Canada, 25 Aug.; Wilbur Ward, 75, past president of the New York Obstetrical Society and former professor of gynecology at the College of Physicians and Surgeons, Columbia University, New York, N.Y., 20 Sept.; Stanley Yocom, 74, retired chief of architecture and engineering of the Philadelphia Board of Public Education, Philadelphia, Pa., 19 Sept.

## Book Reviews

***Government and Science:*** Their dynamic relation in American democracy. Don K. Price. New York Univ. Press, New York, 1954. ix + 203 pp. \$3.75.

Stimulating, thought provoking, full of good common sense and uncommon insight, Price's lectures are a forceful and challenging discussion of the problems and dilemmas on the one hand, and the administrative and legislative solutions and practices on the other, that have been created by the inevitable intermeshing of science and public policy. Price astutely diagnoses the fundamental problem of the new relationship of science to government in terms of the reconciliation of basic freedom with responsible authority.

Recognizing the reciprocal nature of this relationship, Price begins with an intriguing, albeit speculative, excursion into the sociology of knowledge as applied to American political history. He attempts to show that the philosophical scientists of the 18th century paved the way for our republican revolution. He also maintains that the scientific research programs and thought patterns of the 19th and 20th centuries laid the foundation for the development of government services, the extension of governmental powers, and the creation of those forms of organization and systems of personnel that, in practice, determine the workings of governmental authority. He then reviews the World War II developments, with particular emphasis on the Office of Scientific Research and Development and the dangers of political interference with science. His own conviction is that science is best protected against political interference if it is given "a direct and effective relationship with the responsible executives, as well as the support of well-organized groups of advisers from the leading private institutions of the nation."

Both respect and concern are revealed in the author's critical analysis of the contract system, the various advisory mechanisms, and the special difficulties arising from security considerations and congressional investigations. There is admiration for the ingenuity and patriotic fervor which created administrative mechanisms sufficiently flexible and adaptive to make the best use of the potentialities of science in furthering public policies. At the same time, there is anxiety lest the pressure of events and the development of technology outrun our administrative capabilities. One of Price's major concerns is the need of scientists to develop sharper understandings of their own roles as advisers to government administrators and deeper appreciation of the extrascientific considerations that the latter must weigh in the execution of their policy responsibilities. As recent events clearly show, the scientist-administrator relationship is a difficult one to create, nurture, and maintain, and yet it is essential to our national well-being.

To insure the progressive development of both free science and free government is the difficult task we

face in mid-century. For scientists, legislators, and administrators, in fact for all who are concerned with reconciling the responsibilities of democratic government with the requirements of intellectual freedom, *Government and Science* is an indispensable source of insights, knowledge, and clearly defined issues. The author quite properly admits that he does not have all the answers, but he is certainly an expert in asking the important questions.

Vannevar Bush, commenting in the *New York Times Magazine* (13 June 1954) on the effective working partnership developed during World War II between professional men and officers of government, remarked that "This partnership, so essential to our future safety, has been gravely damaged and is being gradually destroyed." We are, apparently, in urgent need of more Don Prices to help us acquire, before it is too late, the political genius and administrative wisdom to recreate on firm foundations the effective and essential partnership of free science and free government in a democratic society.

HARRY ALPERT

National Science Foundation, Washington, D.C.

***Proceedings of the Second International Congress on Rheology.*** V. G. W. Harrison, Ed. Academic Press, New York; Butterworths, London, 1954. ix + 451 pp. Illus. \$10.

The many interesting papers contained in this excellent volume defy any unified description. Perhaps the best a reviewer can do is to quote from the presidential address by G. I. Taylor.

When I was asked to preside at this congress of rheologists my immediate reaction was that I am so ignorant of the details of your work that I should feel like a sheep in a lion's den if I accepted; but when I considered the immense field covered by the term "rheology," I realized that many of you must be in much the same condition as myself. Rheologists who study creep and plasticity in metals for instance might well fail to pass with any credit an examination in the properties of non-Newtonian fluids.

Six general lectures are included: "Sur l'effet électrovisqueux qui se manifeste dans les suspensions colloïdales" by A. Dobry, "Rheological problems in the fabrication of plastics" by R. S. Spencer, "Rheology and applied mechanics" by R. N. J. Saal, "Rheologisches Verhalten und molekulare Platzwechselmechanismen" by F. H. Müller, "Water association and hydrogels" by E. Forslind, and "Some rheological problems in biology" by P. Eggleton. These are followed by 22 papers on high polymers, 19 on viscosity and plasticity, three on biology, and five on oils and greases. A mere listing of the titles would more than consume the space available for a review. The general comments that can be offered are few indeed. One is that

metals do not receive sufficient attention; only two papers have the word metal in their title, and only a few of the other papers are relevant to a study of metals. Another comment is that there is strong evidence in this book of the tendency among rheologists to adopt broader points of view instead of solving very specialized problems with special techniques. For this reason all rheologists will gain by a perusal of all sections of the volume.

D. C. DRUCKER

Division of Engineering, Brown University

**Vapor Pressure of Organic Compounds.** T. Earl Jordan. Interscience, New York-London, 1954. ix + 266 pp. Plates. \$14.50.

The chemical engineer will find this huge compilation of vapor pressure data useful since it is possible to read the vapor pressures of 1492 organic and organometallic compounds to about  $\pm 1$  percent from 168 well printed charts that constitute the heart of the book. These charts are supported either by equations or by references to 1145 tables of vapor pressure-temperature points. Unfortunately the book will not be of much value to physical chemists or to engineers who desire to make their own evaluations. There is no indication whether the tables of values refer to calculated or observed values although most of them contain calculated or smoothed results; and since the author has relied on secondary references to a major extent, his book does not provide a guide to the original literature.

The one page of text and a short preface emphasize that fact that the book is a summary of data, in fact, largely a summary of summaries, but no criteria of judgment are mentioned except graphical examination.

Comparison with D. R. Stull's compilation [*Ind. Eng. Chem.* 39, 517 (1947), reprinted in alphabetical order in *Chemical Engineers' Handbook*, J. H. Perry, Ed. (McGraw-Hill, New York, 1950)] of the evaluated vapor pressure data on over 1200 organic compounds and about 300 inorganic compounds is inevitable because Stull's collection is easily available and Jordan has reproduced 908 of Stull's tables verbatim. This is unfortunate because these values contain noticeable errors just below the normal boiling point, owing to a flaw in Stull's original chart; it would have been better if the basic data had been reworked or at least checked before such an extensive reprinting.

It is impossible to make more than spot checks on the values themselves. However, for 1,2-dibromoethane between 0° and 50°C we have a choice of two equations and the chart, but no two of them agree or even cross. At 10°, one equation gives 4.7 mm, the other 5.9 mm, and the chart 6.6 mm. At 50°, the three values are 42.3, 43.4, and 46.0 mm, respectively. The chart for tetraethyl lead (pl. 3, not 2) is said to be based on the work of Buckler and Norrish (0.056 to 6.3 mm) and on Stull's calculated values based on the same ex-

periments. However the chart line does not correspond to Buckler and Norrish's equation but has a much smaller slope, and their experimental points lie 12 to 25 percent below the chart line. The author also missed the four points at 10, 13, 19, and 290.5 mm by W. J. Jones *et al.* [*J. Chem. Soc.* (London, 1935), p. 39].

Several other examples of this essentially noncritical treatment were evident on close examination of the tables and charts. Since the ordinate scales of the charts are linear with the logarithm of pressure and the abscissa scales are linear with reciprocal absolute temperature, a gentle curvature is expected for the plots of all but very low boiling point compounds. Instead, there are one or more straight lines per compound, sometimes with a disconcerting change of slope (for example, benzene at 100 mm on pl. 7).

In conclusion, I feel that the book has little utility, for the physical chemist and chemical engineer are better served by existing compilations, and the organic chemist dealing with relatively unknown materials will profit by the use of Dreisbach's book [*P-V-T Relationships of Organic Compounds* (Handbook Publ., Sandusky, 1952)] of vapor pressure estimates rather than by attempts to interpolate estimates based on Jordan's charts.

GEORGE W. THOMSON

Ethyl Corporation, Detroit, Michigan

**Tissue Culture as Applied.** Especially within bacteriology and immunology. Ren Kimura. Munksgaard, Copenhagen, Denmark, 1953. 273 pp. Illus. Danish Kr. 14.

This review is designed to summarize some 260 papers published by Kimura and his associates from the Microbiological Institute of Kyoto University. The procedure is to cite first the pertinent literature available prior to World War II, and then the findings in Kimura's laboratory. The broad range of subjects includes: culture mediums and techniques; pure cultures of tissue cells, cultures from various organisms and from malignant tumors; morphology, metabolism, vital staining and phagocytosis; and bacteriological and immunological studies.

Two general areas (factors influencing growth and immunological studies) encompass the major work of this laboratory. The factors studied for their influence on growth were temperature, desiccation, osmotic pressure, ionic concentrations, chemotherapeutic compounds, antibiotics, radiation, homologous and heterologous blood plasma, organ extracts and hormones, and vitamins. Immunological observations include the effects on cells of bacterial toxins, venoms, viruses, Rickettsiae, and cytotoxins. Antibody production has also been studied. Kimura's encyclopedic assembly of observations serves to point out topics on which experiments have been conducted but does not attempt to evaluate the implications of the findings.

JOHN H. HANKS

Department of Bacteriology and Immunology,  
Harvard University Medical School

**Copper.** The science and technology of the metal, its alloys and compounds. Allison Butts, Ed. ACS Monograph Series, No. 122, William A. Hamor, Ed. Reinhold, New York, 1954. xii + 936 pp. Illus. \$20.

This volume is one of the monograph series of the American Chemical Society. It contains 46 chapters, each written by one or more of the leading international authorities, on all the various phases of the technology of copper. The volume is encyclopedian in its scope.

The stated purpose of this composite monograph is "to provide a reference work on all the important phases of the subject of copper both as a chemical element and as an industrial metal." This objective has been carried out admirably, and the resulting volume, containing nearly 1000 pages, should occupy a space on the reference shelf of every engineer, metallurgist, chemist, and technical or scientific worker whose operations bring him in contact with the element copper in any of its forms and applications.

The metallurgical phases of copper are, in general, particularly well covered and, in most cases, with adequate detail, but some aspects might have been more expanded. For instance, the chapter on "Electrolytic refining" occupies 57 pages with 23 references. The subject is exploited in the fullest detail and with perhaps more detail than its relative importance would seem to demand. On the other hand, "Secondary copper and copper alloys" (Chapter 16) is covered in only 8 pages with no references. Considering the very great importance of this subject in our present-day economy, more space should have been assigned to it. The methods of refining secondary material are described only in such general terms that the inclusion of this chapter, as written, seems scarcely worthwhile.

In Chapter 7, the thermodynamics of copper smelting occupies 16 pages with 18 references. The introductory material of this chapter, especially in regard to free-energy changes, could have been treated in more detail. Unless the reader has a good, up-to-date, and working knowledge of modern physical chemistry, he is not likely to be able to apply the equations appearing on pages 152 and 153, even though it is stated:

If the activity values are known, the free-energy changes accompanying reaction with reactants and products at any other than standard states can readily be obtained by combining the  $\Delta^\circ F$  values from the graphs with equation (2).

The reader is told that "A" equals the activity of a constituent. When he turns to his physics textbook he finds that "activity" is defined as the ratio of the fugacity of the substance in the state in which it happens to be to the fugacity in the standard state. When he seeks a concise definition of "fugacity," he jumps into really deep water.

Again, in the treatment of "Analytical chemistry of copper" (Chapter 46), slightly more detail could have been given. Even though it is stated that "the analytical chemistry of copper is reviewed rather briefly"

and that "Due to space limitations no attempt is made to give the details of the laboratory procedures," nevertheless, the commonly used and accurate electrolytic method receives a thorough treatment (3½ pages and about 50 references). Although the gravimetric, iodometric, and other methods, including the colorimetric method, are discussed and amply referenced, it might have been advantageous to include some details of one of each of these methods. This chapter contains 106 references.

Most of the chapters cover their subjects in an adequate and excellent manner, and the book covers the whole subject of copper in practically all its ramifications in a most commendable fashion, including 1289 references to the literature from about 1933 to as late as 1952. Unfortunately, however, six chapters have no references at all. This fact, together with the poor reproduction of at least two diagrams (pages 105 and 157) in which some of the numerals are completely blocked up and undecipherable, is about the only valid criticism that can be made. Only one typographical error was found (page 536), and this was a minor one.

WELTON J. CROOK

School of Mineral Sciences, Stanford University

**Optical Workshop Principles.** Translation of *Le Travail des Verres d'Optique de Précision*. Charles Dévé. Trans. by Thomas L. Tippell. Hilger & Watts, London, and Jarrell-Ash, Newtonville, Mass., Engl. ed. 2, 1954. xxiv + 436 pp. Illus. + plates. 42s.

The first English edition of this work was prepared by Hilger to provide a manual for the training of the many optical workers needed in World War II. The present edition was translated from the third French edition, most of which was written in 1945 and published in 1949. The apparent age of the French original does not detract from the value of the book as a guide to the rationale of optical shop practice.

The author pointed out that the manual was written for apprentices, teachers, shop managers, and others who already know something of the practice of optical surfacing. Some elementary subjects, such as the design and mechanics of grinding machinery, are not discussed. Thus the book is in the nature of a monograph on selected topics of optical work, but the treatment of these is so thorough and practical that it is useful to workers in any stage of training.

The first part of the book, "Elementary," is devoted to glasses, their faults and aberrations; choice of materials; abrasives, glues, cements, tools, polishers; surfacing; and spectacle lenses. The second part, "For the use of works managers and senior workmen," takes up the mechanical theory of working optical surfaces; optical tests in the workshop; polarization of light; crystal working; the construction of several types of polarizing prisms; centering, edging and cementing lenses; reticules, micrometers, graticules; the metallization of mirrors. There are three appendixes; the most significant is on the surfacing of aspherical lenses. There are author and subject indexes. Only a

few typographical errors were found. In the formula for silvering mirrors, on page 343, caustic soda may be meant instead of "soda."

Altogether, the book is excellent and should be of value, not only to the professional optical shop workmen and apprentices for whom it was prepared, but also to scientists and amateurs who have any interest in the grinding and polishing of glass and crystals. It should be in every optical workshop.

LYMAN CHALKLEY  
5320 Middleton Lane, Washington 22, D.C.

**Matthews' Textile Fibers.** Their physical, microscopic, and chemical properties. Herbert R. Mauersberger, Ed. Wiley, New York, and Chapman & Hall, London, ed. 6. 1954. x + 1283 pp. Illus. \$16.50.

This sixth edition of an important reference work originated by J. Merritt Matthews 50 years ago has become a multiauthored compilation of which Mauersberger serves as a coauthor and editor. The great advance of the textile industry in production of synthetic fibers such as nylon, Dacron, Orlon, Acrylon, and Dynel, has required extensive additions to a text designed to cover the properties of these materials and the procedures for identifying them, either alone or mixed with other fibers. The book has been revised throughout with incorporation of new illustrations, new technical data, and extensive additions, not only in synthetic organic fibers, but also in the discussion of inorganic (glass) fibers, and identification and quantitative analysis.

In the discussion of each of the principal types of textile fibers, consideration is given to history and use, statistical information, microscopic characteristics, physical and optical properties, and chemical properties. The latter include effects of solvents, acids, alkalis, and the general dyeing properties of the fiber. The book is limited to the fibers and spun threads, and does not include characterization of woven fabrics produced from these fibers.

WALLACE R. BRODE  
National Bureau of Standards

**Experimental Inorganic Chemistry.** W. G. Palmer. Cambridge Univ. Press, New York, 1954. 578 pp. Illus. \$9.

The author has written a book that combines the theory and practice of inorganic chemistry in a usable, useful, practical, and interesting fashion. It is recommended to all teachers of inorganic chemistry (not to be confused with general chemistry) as a pedagogically stimulating textbook. Emphasis is placed on the laboratory approach. Directions are given, not only for the synthesis of large numbers of typical and representative compounds but also, in many instances, for the analysis of the resulting products. "In analyzing the compounds they [the students] have themselves prepared they find no drudgery."

Some readers will argue that the organization of subject matter on the basis of the Mendeleev classification of the elements is not modern, but this is a minor point since the theoretical material is most certainly up to date. Commendable is the emphasis on structural inorganic chemistry that constitutes an important part of both the introductory summary and the theoretical material preceding the experimental operations in each chapter. Specialists may also criticize choice of theoretical matter, but the teacher will find this book to be the best, if not the only "teachable," textbook covering the practice of inorganic chemistry. It emphasizes the necessity for analysis as an important adjunct to synthesis. Theory is employed to furnish the background for experimental operations. Such an approach is in itself both refreshing and novel, since so many chemists seem to forget, in their Aristotelian quest for knowledge, that chemistry deals with matter. It is a well-balanced textbook and should find wide and favorable acceptance.

L. F. AUDRIETH  
Department of Chemistry and Chemical Engineering,  
William Albert Noyes Laboratory,  
University of Illinois

**The Determination of Crystal Structures.** H. Lipson and W. Cochran. vol. III of *The Crystalline State*, Lawrence Bragg, Ed. G. Bell, London; Macmillan, New York, 1953. ix + 345 pp. Illus. + plates. \$8.

Lipson and Cochran's volume is the third of a series under the general title *The Crystalline State*, edited by Sir Lawrence Bragg. Two decades have passed since the appearance of the first volume, *A General Survey*, written by the editor himself, and the very great advances that have been made in x-ray analysis since Bragg's volume appeared are partly evidenced by a comparison of it with the present work. Volume II, *The Optical Principles of the Diffraction of X-Rays*, by R. W. James (1950), is chiefly devoted to the physics of x-ray scattering.

Lipson and Cochran have concerned themselves with the problems of structure determination "from the stage at which a set of structure amplitudes has been obtained to the final accurate positioning of the atoms." The treatment is practical throughout; matters that are not immediately applicable—for example, the full development of space-group theory—are omitted. The series of volumes does not provide a discussion of modern experimental methods; perhaps a review of these is contemplated in a future volume.

Here is a work of tremendous practical value to crystal-structure analysts; and at the outset, I express my personal admiration for the amount of material and experience that have been assembled and the splendid way in which the material is presented.

The work opens with a review of x-ray optics. A discussion of the results of space-group theory follows. The third and fourth chapters are concerned with techniques for computation of structure factors and Fourier series, respectively. The following four chap-

ters deal with structure deduction. The final chapter discusses the accuracy of x-ray structure analysis.

A crystallographer who reads this volume thoroughly will have covered a large sample of the experience of many years, the best of the art of structure analysis, and a splendid account of mathematical methods. Major emphasis is placed on the surmounting of the phase problem. The recently published monograph by Hauptman and Karle [*Solution of the Phase Problem*, A.C.A. Monogr. No. 3, Wilmington, Del. (1953)], which claims to present "a routine procedure for determining the phases of the structure factors which is valid for all centrosymmetric space groups," is in part erroneous—as Vand and I have shown [*Statistical Approach to X-Ray Structure Analysis*, Penn. State Univ. (1953)]. If it were not, most of Lipson and Cochran's book would be unnecessary. No general solution of the phase problem in x-ray analysis exists, as yet; thus this extremely important field still remains an art, which the present volume beautifully summarizes. It is extremely necessary that analysts not be discouraged from continuing their search for more powerful phase-determining methods. Until these are available, the present collation of available methods is of critical value.

As might be anticipated in a discussion of a field that is growing at a fast rate, which describes methods that are to some extent necessarily selected on the basis of personal preference, the authors occasionally weight certain techniques too much, and underemphasize or ignore others. On page 14, for example, the statement appears, in connection with the interpretation of Patterson syntheses, that "no general method of deducing atomic positions has yet been put forward that will work in any but the simplest crystals." A fairly extensive discussion in Chapter 6 tends to ameliorate this view, which is somewhat shortsighted. Present developments tend to suggest that Patterson-interpretation methods, and particularly those along the lines under development by M. J. Buerger, hold large hope for direct structure analysis. These already have some quite complex structures to their credit and can be shown to have operated successfully when all other known methods have apparently failed.

The discussion on pages 143-144 of the combined use of electron or neutron scattering in conjunction with x-ray scattering is very sketchy and occasionally incorrect and, in general, might have been given more thought. The difficulties of neutron single-crystal diffraction are much less than the authors suggest, and the potentialities of deuterium-hydrogen replacement, for example, are tremendously advantageous for structure-factor phase determination. On the other hand, comparison of x-ray and neutron scattering as a means of phase determination will in general be a difficult matter for structures composed of two or more kinds of atoms, since the x-ray data must be reduced to those for point scatterers if these are to be comparable to neutron data.

The treatment of homometric structures could have been extended, and warnings emphasized on the occur-

rence of near-homometric structures. An example of such a structure is that of triphenylene [A. Klug, *Acta Cryst.* 3, 165, 176 (1950)]. The published structure, which is remarkable for some reportedly very short intermolecular distances, is actually incorrect [V. Vand and R. Pepinsky, to be published]. Unfortunately this structure is used as an example of the successful application of the molecular transform method (pp. 230-233).

The statement on pages 174-175 that little is to be gained by subtraction of the origin peak in a three-dimensional Patterson is open to serious question. Examples can be presented in which such origin-peak removal is distinctly advantageous. The chief difficulty in origin-peak removal is that it can easily be performed incorrectly if proper care is not taken with the statistics of occurrence of reflections.

More could be said about the determination of non-centrosymmetric structures or structure projections, since these are becoming increasingly possible and important. Some discussion of the special problems of large-molecule analysis would have been advantageous, and it is rather surprising to find it missing.

More could be said, furthermore, about the determination of anisotropic temperature vibrations, the determination of bonding electron distribution, the location of hydrogen and other light atoms, and so forth. The important field of study of crystal transitions is omitted entirely.

The discussion of computing methods is excellent as far as it goes, but it omits important techniques that were surely known to the authors.

These are matters of small moment in a work that provides crystallographers with a wide collation and evaluation of practical structure-analytical methods. It is a volume for which we have long waited and are indeed grateful.

RAY PEPINSKY

*X-Ray and Crystal Analysis Laboratory,  
Pennsylvania State University*

**Amebiasis.** Ernest Carroll Faust. Charles C Thomas, Springfield, Ill., 1954. xi + 154 pp. Illus. \$4.75.

This short 168-page monograph by a world authority on tropical diseases provides a clear and concise picture of amebiasis.

The author discusses in sequence geographic distribution, natural history, pathogenesis and pathology, manifestations and clinical evidence, diagnosis and treatment, and control. The chapters on manifestations and clinical evidence might have been combined with the chapter on diagnosis and treatment to make it easier to find the clinical picture, diagnosis, and treatment of the various forms of the disease in one section. Portions of these two chapters are redundant, and differential diagnosis is not adequately discussed.

The chapters on natural history and control, although interesting and well written, might have been shortened, and more space might have been allotted to a more critical presentation of the clinical picture

and the difficulties in diagnosis. The statement that "except in emergencies the possibility of amebic etiology of appendicitis should be carefully explored before surgery is decided upon" is to be questioned in caring for most patients with acute abdominal pain.

However, in general, this book provides a great deal of information and an excellent bibliography on the complicated subject of amebiasis. Both the family physician and the specialist will find it a valuable addition to their library.

K. R. CRISPELL

*Department of Internal Medicine,  
University of Virginia School of Medicine*

**The Present State of Physics.** A symposium presented 30 Dec. 1949 at New York meeting of AAAS. Arranged by Frederick S. Brackett. AAAS, Washington, D.C., 1954. vi + 265 pp. Illus. \$6.75. (Members, \$5.75).

The papers here presented give excellent introductions to various fields of research in physics and biophysics on the level of a college graduate.

P. Kusch gives a lucid discussion of the magnetic moment of the electron. He describes the atomic beam method for observation of the hyperfine structure of atomic lines and briefly discusses the correlation of the experimental results with the various steps of the theory, culminating in Schwinger's treatment of the interaction between the electron and the quantized radiation field.

Two papers are devoted to cosmic rays. E. P. Ney discusses the particles and processes that are observed in cloud chambers and emulsions at balloon altitude, that is, around 90,000 ft, where the primary cosmic rays are predominant, and where some heavy primaries are present with abundances at least as great as their abundances in terrestrial or stellar matter. J. C. Street surveys the processes by which the primaries, which (in rare cases) may have energies up to  $10^{17}$  ev, gradually change to the cosmic radiation as observed at sea level. In particular, he discusses the production of  $\pi$  mesons and their decay to  $\mu$  mesons. The two papers on cosmic rays reproduce numerous very instructive cloud chamber photographs.

An article by K. Lark-Horovitz on "the new electronics" gives a historical outline of semiconductor problems and a special discussion of the electric and optical properties of germanium semiconductors in bulk form as they are affected by chemical impurities and lattice defects. The thoroughness of this article is evident from the fact that it occupies a quarter of the book and gives 352 references.

The next article, by J. Bardeen, is concerned with the transistor. Starting from a brief review of the properties of semiconductors, he presents some of the basic equations governing the flow in semiconductors and applies them to the interpretation of the transistor.

A von Hippel interprets the ferroelectric properties of barium titanate, which, better than any other ferro-

electric substance, lends itself to fundamental investigations and applications. Its transparency permits the striking optical demonstration of the "domains" and their changes in an alternating electric field.

P. J. W. Debye investigates the structure of polymers, combining the various experimental methods: scattering of light, index of refraction, depolarization of the scattered light, turbidity, dielectric constant, and viscosity.

The article of R. Lumry and H. Eyring takes us into the field of biophysics. Its title is "Implications of the chemical kinetics of some biological systems." The authors explore to what extent the laws of thermodynamics and chemical kinetics lead to the understanding of certain biological processes.

I feel that the field of biophysics would gain from more active cooperation by physicists. However, physicists are not attracted to biophysics, since here the problems are presented by the biologist, and the collaborating physicist may frequently consider himself a technical assistant. The last two articles will help overcome the reluctance of the physicist by presenting biophysical problems from the biologist's point of view. These articles are by Frank Brink, Jr., "Some physical and chemical properties of axons related to conduction of nerve impulses," and by Frank H. Johnson, "Bioluminescence and the theory of reaction rate control in living systems."

The papers were presented at a symposium 30 Dec. 1949. Only a few papers give any more recent references. In a period of rapid progress, many readers who want to familiarize themselves with the present state of research may try to find more recent sources than this symposium, excellent as the papers are.

O. OLDENBERG

*Lyman Laboratory of Physics,  
Harvard University*

**Problems of Consciousness.** Transactions of the Fourth Conference, 29-31 Mar. 1953. Harold A. Abramson, Ed. Josiah Macy, Jr. Foundation, New York, 1954. 177 pp. Illus. \$3.25.

The interdisciplinary conference on problems of consciousness, sponsored by the Macy Foundation, has now completed its fifth and final annual meeting. Each year a panel of distinguished scientists, mostly from the medical and social sciences, spend 3 days in a leisurely examination of some of the problems of the field. At each meeting there are a few formal presentations, but most of the time is reserved for free discussion, all of which is recorded for subsequent publication.

A serious assessment of the value of the conference should await the appearance of the fifth volume, presumably now in preparation. The fourth report leaves one with some doubts as to the appropriateness of this topic for an interdisciplinary conference, particularly when the membership is notably lacking in people with technical philosophical training. "Consciousness"

is not a neat, clearly identifiable problem area like the functions of the adrenal cortex, the conditions of blood clotting, or the nature of the nerve impulse. It is a concept about which metaphysicians and epistemologists have worried for centuries, a concept that must be given at least a provisional definition before scientists can profitably make it the object of interdisciplinary study.

A working agreement as to the nature of the problem may have been achieved at the first meeting, but if so, it seems to have been forgotten. The record of the fourth meeting presents three short and extremely able papers by Roy R. Grinker, Talcott Parsons, and Jean Piaget, respectively, followed by 121 pages of discussion. Individual contributions are always interesting and frequently informative, but it is difficult to find any thread of development that suggests that a problem is being gradually clarified. Perhaps the final volume will provide the needed synthesis.

ROBERT B. MACLEOD

Department of Psychology, Cornell University

***A Field Guide to the Birds of Britain and Europe.***

Roger Tory Peterson, Guy Mountfort, and P. A. D. Hollom. Houghton Mifflin, Boston, 1954. xxxiv + 318 pp. Illus. + plates. \$5.

So far as illustrations are concerned, this attractive pocket volume is entirely the work of the American ornithologist and bird painter, Roger Tory Peterson. Of these, there are 1200, and they follow the familiar Peterson method which is primarily patternistic. Six hundred and fifty-four of the illustrations are in color, and a more gemlike brilliance and precise register could not be asked. The text is the work of two well-known British ornithologists. Guy Mountfort is largely responsible for the immense labor of compiling a complex book for which the scientific literature of some 20 languages for the past many years had to be reviewed, and for which the nomenclature of numberless authors had to be weighed and edited into the latest official usage. The 380 distribution maps showing breeding and wintering grounds and the descriptions of the ranges are the work of P. A. D. Hollom. Subspecies are dealt with only when recognizable in the field. Dutch, French, German, and Swedish names are added to the English names, and North American names are included where the bird is conspecific but the name is different (for example, sand martin in England, bank swallow in America, for *Riparia riparia*). Foreign editions in these other languages are scheduled for early publication.

The present volume includes every one of the 551 species of Europe west of the U.S.S.R., which apparently has been excluded for reasons of poor communication and fieldwork facilities at the present time. Even so, Russian ornithological literature has been researched and much of its results included.

Speaking as an American who lived for 6 years in Europe, always deep in the country, I can say that many hours of fruitless search would have been saved

me if I had possessed the present volume while trying to identify hoopoes, rollers, wall-runners, and the many species of *Sylvia*, so strange to New World eyes. This pocket volume will certainly accompany me on my trip to Europe next spring, as more important to a naturalist than language phrase-books or guides to art treasures.

DONALD CULROSS PEATTIE

Santa Barbara, California

***Electronics.*** A textbook for students in science and engineering. Thomas Benjamin Brown. Wiley, New York; Chapman & Hall, London, 1954. xi + 545 pp. Illus. \$7.50.

This textbook deals quite broadly with the field of electronics. The topics range from physical electronic principles to microwave applications. The treatment is essentially descriptive with a minimum of mathematical analysis. It would appear to be most suitable for use in a course for students whose major field of interest is other than electronics. For this reason, Brown's book will no doubt be welcomed by those schools that offer survey courses in electronics for students in mechanical and chemical engineering.

I feel that the inclusion of laboratory experiment instructions in the body of the text is unfortunate since the continuity of material is sacrificed, and the book is, therefore, somewhat difficult to read. A further handicap is the use of somewhat unconventional terminology such as "full-cycle power supply" rather than "full-wave rectifier" and "feedback product" rather than "loop gain."

This textbook should prove helpful to individuals who wish to gain a general knowledge of the present state of the electronic art.

LEONARD O. GOLDSTONE

Polytechnic Institute of Brooklyn

***The Biochemistry of Genetics.*** J. B. S. Haldane. Macmillan, New York, 1954. 144 pp. \$2.75.

Although the author states that this book is written for the biochemist, and not for the geneticist, there is no doubt that most geneticists can gain a great deal from it. In fact, the geneticist is told in many ways that the future of genetics is in the physiological approach and also that most of the simple chemical models that the geneticist uses are obsolete. There is not only a reiteration of the generally accepted premise that there is a biochemical basis underlying all genetically controlled variations, but there is also an emphasis on how little is really known about the processes themselves and the associated inhibitions, competitions, rates, and so forth. Most biochemical processes that have been studied are remote from the primary gene action.

Haldane speculates in a manner that is pleasing, being neither overly dogmatic nor overly apologetic. The thesis that there is a major evolutionary trend toward

biochemical complexity is an interesting possibility. Associated with this is his suggestion concerning heterozygosity and mixed enzymes. His views on adaptive enzymes, mutagenesis, and crossing-over are certainly provocative. For the biochemist, this book will indicate some of the questions that the physiological geneticist wants answered; for the geneticist, the book will indicate some of the potentialities of a biochemical approach.

HERMAN B. CHASE

Department of Biology, Brown University

## New Books

- Plant Regulators in Agriculture.** H. B. Tukey, Ed. Wiley, New York; Chapman & Hall, London, 1954. x + 269 pp. Illus. \$5.50.
- Annual Report of the Board of Regents of the Smithsonian Institution.** Showing the operations, expenditures, and condition of the Institution for the year ended 30 June 1953. Pub. 4149, 1954 (Order from Supt. of Documents, GPO, Washington 25). ix + 481 pp. Illus. + plates. \$3.75.
- The Design and Use of Instruments and Accurate Mechanism.** Underlying principles. T. N. Whitehead. Dover, New York, printing 2, 1954. xiv + 283 pp. Illus. Paper, \$1.95; cloth, \$3.50.
- Exploring Our National Parks and Monuments.** Devereux Butcher. Houghton Mifflin, Boston, ed. 4, 1954. viii + 288 pp. Illus. \$4.50.
- Plastics Engineering Handbook.** Society of the Plastics Industry. Reinhold, New York, ed. 2, 1954. xxxv + 813 pp. Illus. \$15.
- Teen-Agers.** A health and personal development text for all teen-agers. Gladys Gardner Jenkins, W. W. Bauer, and Helen S. Shacter. Scott, Foresman, Chicago, 1954. 288 pp. Illus. \$3.60.
- Bibliography and Index of Geology Exclusive of North America.** vol. 18. Marie Siegrist, Mary C. Grier, and Marcia Lakeman. Geological Society of America, New York, 1954. xiv + 599 pp.
- Readings in General Psychology.** Lester D. Crow and Alice Crow. Barnes & Noble, New York, 1954. x + 437 pp. Illus. Paper, \$1.75.
- Monomeric Acrylic Esters** Edward H. Riddle. Reinhold, New York, 1954. vii + 221 pp. Illus. \$5.
- Men of Other Planets.** Kenneth Heuer. Viking, New York, reissue, 1954 (Pellegrini & Cudahy, New York, 1951). ix + 160 pp. Illus. \$3.
- Collections of a Century.** The history of the first hundred years of the National Museum of Victoria. R. T. M. Pescott. National Museum of Victoria, Melbourne, 1954. x + 186 pp. Illus.
- Practical Physiological Chemistry.** Philip B. Hawk, Bernard L. Oser, and William H. Summerson. Blakiston, New York, ed. 13, 1954. xvi + 1439 pp. Illus. \$12.
- An Introduction to the Study of Fossil Plants.** John Walton. Black, London, ed. 2, 1953 U.S. distr.: Macmillan, New York. x + 201 pp. Illus. \$4.75.
- Explaining the Atom.** Selig Hecht. Rev. by Eugene Rabinowitch. Viking, New York, 1954. xviii + 237 pp. Illus. \$3.75.
- Biochemical Determinants of Microbial Diseases.** René J. Dubos. Harvard Univ. Press Cambridge, 1954. viii + 152 pp. \$3.50.

## Miscellaneous Publications

- Notes on Frogs of the Genus *Teimnotobius*, with Descriptions of Two New Peruvian Species.** Fieldiana; Zoology, vol. 34, No. 26. Karl P. Schmidt. Chicago Natural History Museum, Chicago, 1954. 10 pp. Illus. 20¢.
- Rabies.** Bull., vol. 10, No. 5. World Health Organization, Geneva, 1954 (Order from Columbia Univ. Press, New York 27). 166 pp. Illus. \$1.50.
- Carbonizing Investigations.** pt. 1, *A Review of the Literature.* Wool Textile Research Labs. Tech. Paper No. 2. D. H. Simmonds. Commonwealth Scientific and Industrial Research Organization, Melbourne, 1954. 12 pp.
- Notulae Criticae ad Floram Hispaniae Pertinentes, I.** Bull., Botany, vol. 1, No. 4. V. H. Heywood. British Museum (Natural History), London, 1954. 40 pp. 10s.
- Design of Flexible Pavements.** Highway Research Bd., Research Rpt. 16-B. Natl. Acad. of Sciences-Natl. Research Council, Washington 25, 1954. 77 pp. Illus. \$1.05.
- Forest Statistics for New York Forest District No. 2.** F. S. Ser., N.Y. No. 4. 19 pp. **Forest Statistics for New York Forest District No. 4.** F. S. Ser., N.Y. No. 5. 19 pp. **Forest Statistics for New York Forest District No. 5.** F. S. Ser., N.Y. No. 6. 19 pp. Northwestern Forest Expt. Sta., Upper Darby, Pa., 1954.
- Taxonomic Status of the Mid-Gulf Coast Amphibia.** Tulane Studies in Zoology, vol. 1, No. 12. Imogene R. Hill. Tulane Univ., New Orleans, 1954. 25 pp. Illus. 35¢.
- Washability Studies of Four Virginia Coals.** Bull., Engineering Expt. Sta. Ser., No. 94. Carl Shelton, Jr. Virginia Polytechnic Inst., Blacksburg, 1954. 40 pp. Illus. 25¢.
- On the Problem of the H $\alpha$  Emission in the Shell Stars.** Contribs. No. 32. Anne B. Underhill. 8 pp. Illus. **On the Strength of the Helium Lines in the O-Type Stars.** Contribs. No. 35. Anne B. Underhill. 13 pp. Illus. Dominion Astrophysical Observatory, Victoria, B.C., 1953.
- Water Waste Control at the Plumbing Fixture.** William R. Wallin. Dole Valve Co., Chicago 12, 1954. 7 pp. Illus.
- Meteorología Marítima y Ciclones Antillanos.** Ernesto Sifontes. The author, Estación Meteorológica-Hidrográfica, Ciudad Bolívar, Venezuela, 1953. 59 pp. Illus.
- Gains for Handicapped Children.** Pamph. No. 212. Herbert Yahraes. Public Affairs Committee, New York 16, 1954. 28 pp. Illus. 25¢.
- Quality and Stability of Canned Meats.** A symposium. Robert G. Tischer, James M. Blair, and Martin S. Peterson, Eds. Natl. Acad. of Sciences-Natl. Research Council, Washington 25, 1954. (Order from QM Food and Container Inst. for the Armed Forces, Chicago 9). 135 pp. Illus. Gratis.
- Attitudes of Male Alcoholic Inmates toward Marriage, Family, and Related Problems.** Arthur Lerner. Natl. Assoc. for Mental Health, New York 19, 1954. 15 pp.
- Report of the Committee on the Measurement of Geologic Time, 1952-1953.** Pub. 319. Natl. Acad. of Sciences-Natl. Research Council, Washington 25, 1954. 187 pp. Illus. \$1.50.
- Report of the Third Conference on Nutrition Problems in Latin America.** Caracas, Venezuela, 19-28 Oct. 1953. Nutrition Meetings Rpt. Ser., No. 8. Food and Agriculture Organization of the United Nations, Rome, 1954 (Order from Columbia Univ. Press, New York 27). 60 pp. 50¢.
- Report to Congress on the Mutual Security Program for the Six Months Ended June 30, 1954.** Foreign Operations Administration, Washington 25, 1954. 63 pp. Illus.

# Technical Papers

## The Lake Altus Wave-Cut Surface in the Wichita Mountain Area, Oklahoma

William F. Tanner

1128 Caddell Lane, Norman, Oklahoma

In the western part of the Wichita mountains of Oklahoma there may be seen an erosion surface, on the granite hills, at an elevation of about 2200 ft above sea level and 500 to 700 ft above the adjacent plains. The best development of this surface occurs on Soldier Mountain and adjacent peaks south of Lake Altus. The surface described here is named from Lake Altus.

Locally the Lake Altus surface is hundreds or even several thousands of feet across, but in general it truncates granite knobs of small mass or encircles, as a platform 50 to 150 ft wide, granite hills of greater mass. The slope of the surface, in the latter instances, is radially outward, in the range 30 ft/mi to somewhat more than 100 ft/mi.

Taylor (1) reported and Evans (2) described in detail grooves or notches cut by wave action on granites of the Wichita mountains. The grooves are approximately horizontal and perfectly parallel, are associated with narrow but distinctive wave-cut platforms, and are developed inside an old sea cave and between the faces of fractures.

No notches have been found above the erosion surface. Commonly the notches are preserved only within 25 to 50 ft of the modern ground surface on the adjacent plains. Inasmuch as they are present at many different elevations (today controlled by the depth of erosion and the elapsed time since the shale cover was removed), the assumption is that at one time they did exist above the erosion surface.

The notches, the radial-outward slope, the low slope angle, the thin veneer of granite boulders on the slope, and the narrowness of the platform indicate that the Lake Altus surface was cut by wave action.

Wave-cut notches have not been reported from the eastern Wichita mountains. The Lake Altus surface is present, however. It has its best development in the eastern part of the mountains on Elk Mountain, north of Indianola. It may be seen on USGS topographic maps of the area (Cache, Cooperton, Saddle Mountain, Snyder sheets). A statistical study of 200 hill-top and 100 random hillside elevations from these four quadrangles indicates a definite accordance between 2200 and 2270 ft and a possible surface between 2400 and 2500 ft. The top of Mount Scott, a flat surface about 700 ft long, fits in the latter interval.

Two similar surfaces at elevations of about 400 to 500 and 900 to 1000 ft above sea level have been studied in the subsurface, north of the western part of the mountains, by means of electric logs and drillers' logs. They also possess radial-outward slopes in the same range of values.

The two surfaces studied from well log data are overlain by coarse arkose and red shales of late Virgil (late Pennsylvanian) to Garber (lower middle Permian) age. The lower surfaces are therefore tentatively dated as late Pennsylvanian and early Permian, respectively. The exposed Lake Altus surface is thought to date from post-Garber, probably middle Permian time.

The sequence of three, perhaps four, surfaces, associated with uncounted wave-cut notches, indicates a late Pennsylvanian and Permian sea advance that may have completely submerged the mountain range. Because the elevation differences among the surfaces is of the order of 2000 ft, subsidence rather than sea-level fluctuation probably accounted for the transgression (3).

### References

1. C. H. Taylor, *Okl. Geol. Survey Bull.* 20, 59 (1915).
  2. O. F. Evans, *J. Geol.* 37, 76 (1929).
  3. For a detailed description, with figures, see *Shale Shaker* (Okl. City Geol. Soc.), in press.
- 6 July 1954.

## Nutritional Studies with the White-Throated Wood Rat (*Neotoma mexicana*)

Robert Van Reen and Paul B. Pearson

McCollum-Pratt Institute,  
The Johns Hopkins University, Baltimore, Maryland

In the development of the science of nutrition, the use of different species of animals has greatly facilitated the advancement of knowledge and the discovery of new dietary factors. The cotton rat and the hamster have been particularly useful in the study of dental caries and in virus work. This prompted us to study the white-throated wood rat, *Neotoma mexicana*, as a mammalian species that might have nutritional patterns of unique value for research (1). During the course of the experiments several interesting observations were made concerning the behavior of wood rats: (i) the wood rats could be maintained on a commercial rat chow but did not readily accept a purified type of diet containing all the nutrients known to be essential for the albino rat; (ii) the water intake was observed to be unusually high; and (iii) when the commercial chow was supplemented with aminopterin, a folic acid antagonist, the wood rats survived for a longer period than mature albino rats.

The wood rat is indigenous to the arid southwestern United States and Mexico and, in its natural habitat, lives where vegetation affords protection from carnivores and shelter from the elements. It is primarily nocturnal. Flowers, fruits, and leaves are the main items of diet. Animals for our studies were obtained from Colorado through the courtesy of the Fish and Wildlife Service of the Department of the Interior.

The rats were captured in Douglas County, Colorado, around sandstone ledges of an area designated as Daniels Park.

Under laboratory conditions, a commercial stock diet for rats appeared to meet the requirements for maintenance and growth. A purified diet normally used for the albino rat was then tried. The diet had the following percentage composition: casein, 25; starch, 64; salt mixture, 4; and corn oil, 7. In addition, the diet was supplemented with the fat-soluble vitamins and all B-vitamins at levels more than adequate for the albino rat. The wood rats did not adapt themselves to the diet, weight responses were unsatisfactory, and food consumption was only about half of the amount consumed on the stock diet. Since it has been reported that the cotton rat responds to liver concentrate, 1 percent of a liver extract was incorporated in the diet to replace an equivalent amount of starch. The wood rats did not respond to this diet either, and food consumption was low.

Studies have suggested an effect of bulk formers on the life-span of rats (2), and since the wood rat normally subsists on a diet that is relatively high in fiber, it was thought that this might be a limiting factor in the diet. One percent of cellulose (Reflux), however, did not improve the acceptability of the diet to the animals. When the animals were given free access to the stock and purified diets either with or without cellulose, they invariably ate the stock diet. The purified diet was also fed in pellet form, but this did not improve its acceptability. In view of Curt Richter's (3) interest in the wood rat and his special facilities for activity studies and multiple-choice feeding techniques, a limited number of animals was made available to him. The wood rats drank large quantities of water, much more than would be taken by domesticated Norway rats, but not much more than would be consumed by wild Norway rats. The spontaneous running activity of the wood rats was low as compared with the activity of wild Norway rats. Of several natural foods and synthetic diet materials used in the multiple-choice feeding system, it was apparent that the rats preferred the natural foods.

Since the experiments using a purified diet did not yield quantitative data, it was considered worth while

to try adding an antimetabolite to the stock diet. Aminopterin (4-aminopteroylglutamic acid) was used, since it will produce an impairment in erythropoiesis in the mouse, white rat, chicken, and monkey. In the white rat a dose of 50  $\mu$ g of aminopterin given intraperitoneally daily will produce marked effect within 5 to 6 days (4). The daily level of aminopterin selected for these studies with the wood rat was 250  $\mu$ g per 10 g of food. On the stock diet, without aminopterin, the average hemoglobin value was 13.5 g per 100 ml of blood and the RBC count 7,690,000. The RBC count and hemoglobin values declined to less than half the original value after aminopterin had been fed for 12 to 35 days. The animals declined in weight, and the amount of food consumed was decreased. The hair coat tended to be rough, and the animals developed a general unthrifty appearance, which was correlated with the decrease of RBC and hemoglobin values. From these preliminary studies, however, it is not possible to conclude that folic acid is a dietary essential, since the possibility of a toxic action of aminopterin has not been eliminated. Adult albino rats of the Wistar strain fed the same quantity of aminopterin survived no longer than 2 wk. This suggests that the wood rat has a sensitivity to aminopterin that is less than that of the albino rat.

Information was also obtained on the excretion of some of the B-vitamins when the wood rats were fed the stock diet. The animals were kept in individual, wire-bottom, metabolism cages, and feces and urine were collected quantitatively for 3 successive days. Standard microbiological procedures were used for determining the riboflavin, niacin, and pantothenic acid contents of urine and feces. The results presented in Table 1 are values for nine animals. It is apparent that there was considerable variation among the animals in the excretion of each of the three vitamins. This reflects, at least in part, the variation in food intake and corresponding variations in the amount of vitamins ingested. It is interesting to note that, of the total pantothenic acid excreted, a much higher proportion was excreted via the renal pathway than was the case for niacin and riboflavin. The intake of pantothenic acid was only slightly higher than the rate of excretion, whereas with riboflavin and niacin the

Table 1. Average excretion and range of riboflavin, niacin, and pantothenic acid.

	Feces		Urine		Total excretion ( $\mu\text{g}/24\text{ hr}$ )	Total intake ( $\mu\text{g}/24\text{ hr}$ )
	( $\mu\text{g}/\text{g}$ )	( $\mu\text{g}/24\text{ hr}$ )	( $\mu\text{g}/\text{ml}$ )	( $\mu\text{g}/24\text{ hr}$ )		
Riboflavin						
Average	22.7	37.4	0.51	12.2	50	119
Range	10.8-34.8	16.6-71.3	.1-1.9	4.7-25.5	21-97	98-196
Niacin						
Average	85.3	132.4	1.5	57.8	190	345
Range	56.0-178.0	78.2-235.5	.1-4.2	11.2-125.4	80-361	144-602
Pantothenic acid						
Average	18.8	29.4	2.0	68.4	98	93
Range	9.4-31.4	14.7-41.5	.05-3.2	1.2-279.4	16-321	76-151

amount ingested was in the order of twice the amount excreted.

Although the wood rat appears to have several characteristics worthy of further investigation, the difficulties encountered in maintaining the animals under laboratory conditions make it unlikely that they will find widespread use. Not only was there a poor growth response to a purified type of diet, but reproduction under laboratory conditions was unsuccessful, as was also reported by Hall and coworkers (5) for the related Florida wood rat, *Neotoma floridana osagensis*.

#### References and Notes

1. Contribution No. 73 of the McCollum-Pratt Institute. These studies were supported by a grant from the National Institutes of Health, U.S. Public Health Service (HEW).
2. A. J. Carlson and F. Huelzel, *J. Nutrition* **36**, 27 (1948).
3. Acknowledgment is made to Curt Richter of The Johns Hopkins Hospital for his participation in this phase of the study.
4. G. M. Higgins, *Blood* **4**, 1142 (1949).
5. E. R. Hall, University of Kansas, personal communication.

11 May 1954.

### A Geothermal Measuring Circuit\*

J. H. Swartz

U.S. Geological Survey, Washington, D.C.

Early in 1949 the U.S. Geological Survey undertook a program of geothermal measurements in drill holes in the Naval Petroleum Reserve in northern Alaska. A multiconductor cable for such measurements was specially designed in the Geological Survey for use in these arctic drill holes. The circuit may be of interest to others making precise temperature measurements at multiple points.

Thermistors were used as the thermal measuring elements because of their high sensitivity: a change in resistance, at room temperature, of -4.4 percent per degree Celsius change in temperature.

The circuit was designed to permit maximum accuracy with a minimum number of conductors in the cable. To achieve this, all the conductors were connected together at the bottom end of the cable (Fig. 1). This assures that each conductor in the cable has the same length and, what is especially important, that each has the same temperature and temperature distribution along its length. One of the conductors was then used as a common return lead for all the circuits. A thermistor was inserted at the desired position in each of the other conductors save one, which was reserved as a test lead. This allows an accurate determination of the circuit resistance for each thermistor circuit with only one conductor for each thermistor and without regard to the nature of the temperature distribution along the cable.

In operation, one terminal of a Wheatstone bridge

is connected to the common lead (Fig. 1). The other terminal is connected, through a multipoint selector switch, to the desired thermistor lead. If  $R_\theta$  is the resistance of the thermistor alone,  $R_L$  the thermistor circuit or lead resistance, and  $R_M$  the measured resistance value,

$$R_\theta = R_M - R_L \quad (1)$$

Because all the conductors in the cable are made of the same wire, all have the same temperature coefficients of resistance,  $\alpha$ ,  $\beta$ , . . . . Moreover, because of their adjacency and parallelism in the cable, all have the same temperatures and temperature distribution, when equilibrium with their surrounding medium has been attained. If the effective temperature of the cable is  $t$  ( $^{\circ}\text{C}$ ),

$$R_L = R_{L0}(1 + \alpha t + \beta t^2 + \dots), \quad (2)$$

where  $R_{L0}$  is the circuit resistance at  $0^{\circ}\text{C}$ . Since the test lead is one of the conductors, the resistance of the test circuit must also be

$$R_T = R_{T0}(1 + \alpha t + \beta t^2 + \dots). \quad (3)$$

Therefore,

$$R_L/R_T = R_{L0}/R_{T0}. \quad (4)$$

Since this ratio is independent of temperature, it follows that

$$R_L/R_T = R_{LC}/R_{TC}, \quad (5)$$

where  $R_{LC}$  and  $R_{TC}$  are the resistances of thermistor circuit and test circuit, respectively, as measured in the laboratory at some convenient calibration temperature  $t_C$  prior to the insertion of the thermistors in the cable. From this it follows that

$$R_L = (R_{LC}/R_{TC}) R_T \quad (6)$$

and

$$R_\theta = R_M - (R_{LC}/R_{TC}) R_T. \quad (7)$$

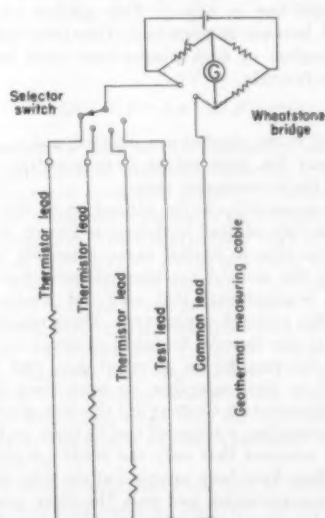


Fig. 1. Diagrammatic wiring circuit for geothermal measuring cable.

\* Publication authorized by the director, U.S. Geological Survey.

The temperature  $t_s$  of the thermistor may then be computed from the equation

$$t_s = [a/(b + \log R_s)] - c, \quad (8)$$

where  $a$ ,  $b$ , and  $c$  are constants characteristic of the particular thermistor and are determined for each thermistor by prior calibration.

By using a four-decade Wheatstone bridge and a sensitive galvanometer with this circuit, it has been found possible to obtain a measurement precision in the field with a probable error of less than  $\pm 0.01^\circ\text{C}$ .

30 June 1954.

## Comparison of Two Methods of Analysis of Rate of Leaf Initiation in *Zea mays* L.

Otto L. Stein and A. Vincent Weber

Department of Botany,  
University of Minnesota, Minneapolis

A method of growth analysis that, until recently, has been little emphasized is the determination of rate of leaf initiation. It has been used in this laboratory in the study of corn morphogenesis. The technique (1) involves the following steps: (i) in each sample, each corn seedling is dissected and the number of leaves produced to date is recorded; (ii) the data are seriated according to leaf stage; and (iii) the average number of days from the date of planting (or from date of pollination, if embryogeny is under consideration) to mid-point of (leaf) stage  $X$  is computed. We refer to this as the *mid-point* method. A curve representing data (marked X) from a current experiment on corn seedling growth thus treated is shown by the solid line in Fig. 1. This method (1, 2) has been used because it permits arithmetical calculation of the duration of each plastochron (leaf stage) by use of the formula,

$$t_x = \frac{1}{2}(x_3 - x_1) + \frac{1}{2}(x_2 - x_3),$$

in which  $X$  is the plastochron number, and  $x_1$ ,  $x_2$ , and  $x_3$  represent the time values from planting to mid-points of three successive stages.

A basic assumption in the utilization of this method is that the rate of leaf initiation is linear. Although this may be true in special cases, generally it is not true. Also, the method has some rather rigorous biostatistical requirements that may not always be attained in the average experiment. These requirements are that (i) the samples be taken at equal time intervals, (ii) the samples be of equal size, and (iii) at any initial or final sampling no more than one leaf stage be represented. Concerning the last point, when a sample comprises a range of two or more leaf stages, it may be assumed that only the tardy plants of the previous stage have been sampled at the time of initiation of the experiment, and only the more precocious plants of the latest stage have been sampled at the time of termination of the experiment. Thus, their

time values contribute to longer and shorter calculated durations of the stage, respectively, than is actually the case.

An alternative method of calculation of rates of leaf initiation (3) has been used in a study of corn embryogeny. In this method, the average leaf stage per sampling date is determined; this is referred to as the *stage-per-day* method. It differs from the mid-point method by omitting seriation. The same data treated in this fashion are shown graphically as circles in Fig. 1. A comparison of the two curves shows agreement in general trends but differences in detail, because the second method is more sensitive to changes in rates. These differences are of considerable biological significance, but they are evident only if sampling intervals are sufficiently brief. Thus, the extremely long duration of plastochron 10 is obscured by the mid-point method because it distributes some extreme time values between plastochrons 9 and 11. Furthermore, the graph demonstrates the discrepancy between the two methods at the upper end of the curves. The mid-point method suggests an increase in the terminal rate of leaf initiation, whereas day-by-day analysis of the same data gives no indication of this. A similar discrepancy would have been noted at the beginning

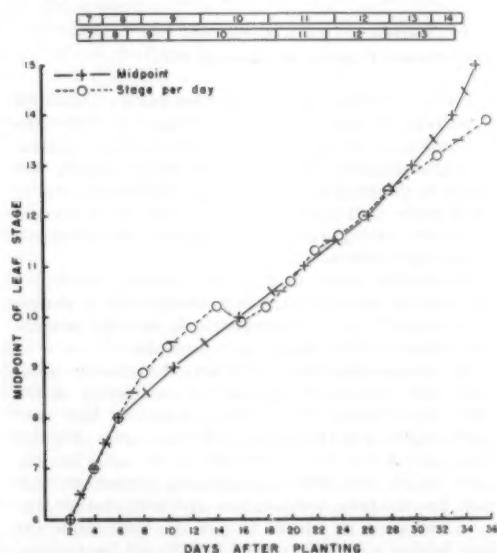


Fig. 1. Rate of leaf initiation of corn seedlings as determined by the stage-per-day method (broken line and circles) and the mid-point method (solid line and x's). Diagonal ticks on the solid line and the upper bar at the top of the figure indicate the duration of successive plastochrons as calculated by the mid-point method. Horizontal ticks on the broken line and the lower bar at the top of the figure represent the duration of successive plastochrons as determined graphically by the stage-per-day method.

of the experiment if some of the embryos of the strain used had been of a different leaf stage.

Some other advantages of the stage-per-day method are not as obvious. Each of the first seven circles in Fig. 1 represents a sample of five plants, and each of the remaining circles represents a sample of 10 plants per harvest. The sample size for the  $\bar{x}$ 's, however, ranges from 3 to 29, being a function of the duration of the stage. It follows that, except in cases of linear-growth rates, equal sample size cannot be attained in the mid-point method. Nor is there any possibility of determining somewhat more subtle changes in growth rate within a stage except by classification into morphological substages (4). Although the mid-point method requires samples of equal size and sampling at equal time intervals, these conditions do not have to be met in the stage-per-day method, since the data from one sample are not combined with those from the others.

As stated earlier, an advantage of the mid-point method is that it permits mathematical determination of the duration of stage, whereas this must be determined graphically in the stage-per-day method. However, depending on the precision desired, points can be obtained close enough to one another to assure accurate determination in the latter case. Horizontal ticks on the broken line of the graph and the lower bar at the top of Fig. 1 represent duration of plastochrons 7-13 thus ascertained.

#### References

1. E. C. Abbe and B. O. Phinney, *Am. J. Botany* **38**, 737 (1951).
  2. E. C. Abbe and O. L. Stein, *ibid.* **41**, 285 (1954).
  3. O. L. Stein, master's thesis, Univ. of Minnesota (1952).
  4. O. L. Stein and E. C. Abbe, *Proc. Minn. Acad. Sci.* **17**, 97 (1949).
- 7 May 1954.

### Estrogenic Activity of Some Isoflavone Derivatives\*

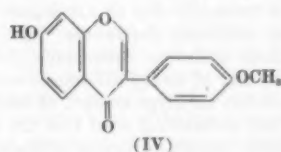
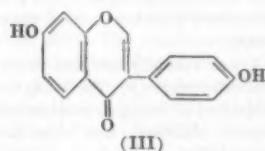
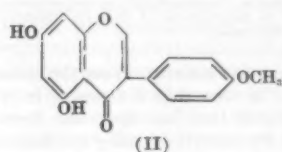
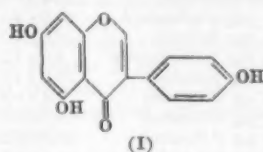
Edmund Cheng, Lester Yoder,  
Charles D. Story, Wise Burroughs

Iowa Agricultural Experiment Station, Ames

Interest in natural estrogenic compounds present in livestock feeds has been stimulated by the beneficial results obtained from the addition of diethylstilbestrol to cattle rations (1). The presence of estrogenic substances in subterranean clover interfering with the breeding performance in sheep (2) has led to the isolation of an isoflavone derivative, genistein, as one of the active substances (3). Cheng *et al.* (4) reported that genistein, as well as the glucoside of genistein, known as genistin, was estrogenic as detected by the mouse uterine response procedure. The estrogenic activity of genistein has further been confirmed by Carter *et al.* (5).

Since there are several known isoflavone compounds

present in natural plant material, it is of interest to determine which of these compounds are estrogenic. Chemical synthesis of four isoflavone derivatives, genistein (I), biochanin A (II), daidzein (III), and formononetin (IV), has been completed in this laboratory (6). Their structural formulas are shown here.



Unpublished data in this laboratory indicated that both synthetic and naturally occurring genistein have equally potent estrogenic activity. Consequently, only synthetic isoflavone compounds were tested in the present experiment. These compounds were fed to mice at a level of 1.25 mg/g of ration in testing estrogenic activity using the uterine response technique (7). The respective isoflavone compounds were first dissolved in ethanol, then mixed with the basal ration, and the ethanol was evaporated from the completely mixed ration. Since the mice consumed an average of 2 g of diet daily, the average intake of the respective compounds was 2.5 mg daily over the experimental period of 4 days. The results of this experiment are presented in Table 1.

It is readily apparent that each of these isoflavones is estrogenic in nature. Daidzein appears to be the most active substance. Genistein and biochanin A have approximately equal activity. Formononetin showed

Table 1. Estrogenic activity of some isoflavone derivatives.

No. of mice	Treatment	Avg. uterine weight (mg)	Approx. potency*
6	Normal control	6.4 ± 0.8†	
6	2.5 mg biochanin A	20.9 ± 3.1	0.033
5	2.5 mg daidzein	26.6 ± 4.1	.042
6	2.5 mg formononetin	8.9 ± 1.2	.009
5	2.5 mg genistein	19.3 ± 1.3	.030
6	0.01 µg stilbestrol	9.4 ± 0.8	
6	0.02 µg stilbestrol	15.7 ± 1.5	
6	0.04 µg stilbestrol	22.2 ± 2.1	
5	0.08 µg stilbestrol	46.2 ± 4.7	

\* Expressed as micrograms of diethylstilbestrol activity.  
† Standard deviation.

the least estrogenic activity. From the structural formula, it can be seen that formononetin is the only compound tested that has only one free hydroxyl group. Since the activity in many synthetic estrogenic compounds is known to be related to the number and arrangement of hydroxyl groups (8), it is not surprising that formononetin is less active than the other compounds tested.

Biochanin A was recently isolated from red clover and found to be estrogenic (9). The isoflavone daidzein has not been reported as being present in nature. However, its glucoside, daidzein, has been isolated from soybean-oil meal (10).

It appears likely that the estrogenic activity in live-stock feeds is primarily due to compounds classified chemically as isoflavone derivatives. The estrogenic potency of these isoflavone compounds is low when compared with that of diethylstilbestrol; nevertheless, when one considers the large amount of such feeds as legume hay and soybean-oil meal that are consumed by farm animals, enough estrogenic substance may be present in these feeds to exert an important influence upon their physiological functions. The effect may be adverse if too much of the estrogenic substance is present, as in the case of subterranean clover (2). On the other hand, if the correct amount is present, the effect may be as beneficial as diethylstilbestrol in stimulating live-weight gain in beef cattle as shown by Burroughs *et al.* (1).

#### References and Notes

1. Journal paper No. J-2530, Iowa Agricultural Experiment Station, Ames, project 1208.
2. W. Burroughs *et al.*, *Science* **120**, 66 (1954).
3. H. W. Bennetts *et al.*, *Australian Vet. J.* **22**, 2 (1946).
4. R. B. Bradbury and D. E. White, *J. Chem. Soc.* **1951**, 3447 (1951).
5. E. Chenz *et al.*, *Science* **118**, 164 (1953).
6. M. W. Carter *et al.*, *Proc. Soc. Exptl. Biol. Med.* **84**, 506 (1953).
7. L. Yoder *et al.*, *Proc. Iowa Acad. Sci.*, in press.
8. E. Cheng *et al.*, *J. Animal Sci.* **12**, 507 (1953).
9. U. V. Solmussen, *Chem. Revs.* **37**, 481 (1945).
10. G. S. Pope *et al.*, *Chemistry & Industry* **1953**, 1092 (1953).
11. E. Wals, *Ann. Chem.* **489**, 118 (1931).

27 May 1954

## Antiaccelerator and Antiarrhythmic Cardiac Action of Synthetic Steroid Alkamines

S. Margolin,\* Go Lu,† J. Yelnosky, A. Makovsky

Pharmacological Research Department,  
Schering Corporation, Bloomfield, New Jersey

The demonstration of antiaccelerator cardiac activity for the synthetic steroid secondary amine, 20-(5'-methyl-2'-piperidyl)-5-pregnen-3,20-diol (1, 2), prompted the synthesis of several steroids with alkamine substitutions in the 16 position by D. Gould and E. B. Herschberg in the Chemical Research Division of Schering Corporation. Our objective was a potent antiaccelerator agent suitable for studies in human beings.

Antiaccelerator cardiac action was first observed in our series with Sch 1837, 16-N-piperidinopregnenolone. This substance and closely related derivatives are strongly convulsant in nonanesthetized dogs at antiaccelerator dosages. However, the activity in this structure encouraged further synthetic efforts, and pharmacological studies brought attention to cyclohexylamine derivatives of pregnenolone. Sch 2331, 16-cyclohexylaminopregnenolone, displayed antiaccelerator activity, and antagonized experimentally induced auricular and ventricular arrhythmias. Sch 2602, 16-cyclohexylaminopregnanediol, was highly effective as an antiaccelerator and antiarrhythmic agent, but it disclosed no important advance over Sch 2331 from a toxicity standpoint. Although these two compounds provided a distinct advance over earlier preparations and could display cardiac activity in non-anesthetized dogs, they induced central stimulation at doses only slightly above those causing antiaccelerator or antiarrhythmic activity. Further experiments demonstrated the greater activity of Sch 2684, 16-cyclohexylamino-allopregnanediol, and indicated its relative safety. Sch 2331, Sch 2602, and Sch 2684 present a new active chemical series with a noteworthy pharmacological combination of highly effective cardiac antiaccelerator and antiarrhythmic action.

The antiaccelerator effect of Sch 1837 and Sch 2331 was suggested by the observation of a distinct slowing of heart rate after injection of these substances into normal and atropinized anesthetized dogs. The compound prepared by Uhle (1) and Sch 2684 behave similarly in such tests. Evidence for a direct cardiac action was obtained with isolated perfused rabbit hearts (Langendorff preparation) and by dog heart-lung experiments (after Krayner, 3). The positive chronotropic action of epinephrine on isolated rabbit hearts was partially or completely blocked by 5 to 50 µg per heart of Sch 2684 without diminishing the positive inotropic response to the epinephrine. In the dog heart-lung preparations, 7 mg of Sch 2684 in a single dose blocked the cardiac acceleration induced by a continuous infusion of epinephrine hydrochloride at a rate of 10 to 45 µg/min, whereas the cardiac output remained essentially unaltered. Marked slowing of the pulse rate in preliminary clinical trials with Sch 2684

appears to parallel the antiaccelerator behavior of the compound in dog studies.

Antiarrhythmic activity was observed in experimentally induced auricular and ventricular arrhythmias. Auricular fibrillation induced by local application of Mecholyl chloride to the sinus-node region accompanied by mechanical pinching (4) was consistently arrested or prevented by intravenous injection of Sch 2684 (1.5 to 4.0 mg/kg) in anesthetized, vagotomized open-chest dogs. Intravenous quinidine sulfate arrested or prevented the arrhythmias at 2 to 4 mg/kg. Protection against the induction of arrhythmias was not as complete as with Sch 2684, and higher doses (10 mg/kg) of quinidine precipitated ventricular tachycardia and fibrillation in some animals. No ventricular tachycardia or fibrillation was observed after Sch 2684; in rare instances, transient premature ventricular contractions were found.

Auricular arrhythmias induced in dog preparations by subepicardial injection of aconitine nitrate at the sinus-node area (5) were antagonized by 2 to 4 mg/kg of Sch 2684 given intravenously; moderate or marked slowing of the ventricular rate, sometimes accompanied by a partial or full reappearance of P waves, occurred and indicated a diminution in the rate of formation of abnormal impulses. Under comparable conditions, intravenous quinidine sulfate (4 to 8 mg/kg) in divided doses produced only partial reappearance of P waves and inconsistent slowing of the heart rate.

In experimental ventricular tachycardia induced by intravenous ouabain (6) in nonanesthetized dogs, consistent slowing of the ventricular rate with complete reversion to sinus rhythm occurred in approximately one-half of the tests following intravenous Sch 2684 (2 to 4 mg/kg) in single or divided doses. In comparable tests, intravenous procaine amide hydrochloride at 4 to 12 mg/kg in divided doses caused partial reappearance of P waves and slowing of the ventricular rate; complete abolition of the arrhythmia occurred at 12 to 28 mg/kg. Ventricular tachycardia induced in nonanesthetized dogs by ligation of the anterior descending branch of the left coronary artery (7) was slowed by 4 to 6 mg/kg of Sch 2684 intravenously, and sinus rhythm reappeared following 6 to 10 mg/kg. Under similar conditions, procaine amide generally restores sinus rhythm at 20 mg/kg given intravenously.

In electrocardiographic studies, Sch 2684 failed to cause any significant changes in the ECG (Standard Limb Lead II) pattern after the injection of antiaccelerator or antiarrhythmic dosages. Following repeated 4-mg/kg injections of Sch 2684 to anesthetized dogs during approximately 10 min, these changes were pres-

ent: (i) prolongation of the measured P-R interval in most tests (after 8 to 12 mg/kg), but P-R remained essentially unaltered as correlated with changes in heart rate; (ii) lengthening of both the measured and the relative Q-T duration as expressed by the Q-T ratio following 8 to 12 mg/kg; (iii) increase in the duration of the Q-R-S complex after 4 to 12 mg/kg; (iv) further decrease in the amplitude of the R wave and increased amplitude of the S wave; (v) gradual increase of T wave voltage initially and then slight decline; (vi) decrease in heart rate with or without initial slight transient (1 to 2 min) increase. The changes generally magnified with increasing amounts of the compound.

The selectivity of Sch 2684 is indicated by the absence of: significant antihistaminic activity, antispasmodic action on the gastrointestinal tract, classical anticholinergic action, central stimulating or emetic effects at antiaccelerator or antiarrhythmic dose levels. The compound does not block the pressor response to epinephrine or cause epinephrine reversal in blood-pressure experiments. The contraction of the cat nictitating membrane produced by faradic stimulation of preganglionic fibers of the superior cervical ganglion is not influenced by the intravenous injection of 8 mg/kg of Sch 2684. The substance appears to possess a rather selective adrenergic (antiaccelerator) effect against epinephrine in the heart. The site of antiaccelerator action might reside at the sinus node. The mechanism of the antiarrhythmic action remains unclear, although it may be related to the adrenergic effect on the heart.

The clinical study of Sch 2684 in cardiac arrhythmias that have responded to quinidine sulfate or procaine amide hydrochloride (8) appears to merit consideration. The presence of cardiac antiaccelerator properties suggests specific application in sinus tachycardia and cautious trial in the management of cardiac acceleration occurring with myocardial infarction or essential hypertension.

#### References and Notes

- \* Present address: Pharmacology Department, Maltbie Laboratories, Morristown, N.J.
- † Present address: Pharmacology Department, Johnson and Johnson Research Foundation, New Brunswick, N.J.
1. F. C. Uhle, *J. Am. Chem. Soc.* **73**, 883 (1951).
2. O. Kraye et al., *J. Pharmacol. Exptl. Therap.* **102**, 261 (1951).
3. O. Kraye, *ibid.* **96**, 427 (1950).
4. H. E. Hoff and L. H. Nahum, *Am. J. Physiol.* **129**, 428 (1940).
5. D. Scherf, *Proc. Soc. Exptl. Biol. Med.* **64**, 233 (1947).
6. J. Yelnosky and S. Margolin, *Federation Proc.* **13**, 419 (1954).
7. A. S. Harris, *Circulation* **1**, 1318 (1950).
8. D. Scherf, *ibid.* **3**, 756 (1953).

10 May 1954.

## Communications

### Demonstration of Fumarase in Cell-Free Preparations from *Paramecium caudatum*\*

The presence of an enzyme catalyzing the hydration reaction



in cell-free preparations from *Paramecium caudatum*, variety 2, type IV (1) has been demonstrated by means of paper-partition chromatography. Other reported studies of enzymes of the Krebs cycle occurring in preparations from these organisms are limited to those of Humphrey and Humphrey (2, 3), who have reported the presence of succinic dehydrogenase on the basis of oxygen uptake studies with methylene blue as a hydrogen acceptor.

The organisms were grown in 4-lit serum bottles in 3 lit of culture mediums containing boiled wheat straw extract (50 ml), dried lettuce (50 mg), and dried skim milk (10 mg), which promoted a bacterial flora upon which the organisms lived. They were concentrated by inducing them to swim upward toward a light at a small orifice from which they could be bled off. The concentrated organisms were washed repeatedly with distilled water to remove the major bacterial contamination. The cell-free preparations were made in a Mickle tissue disintegrator (4) by vibrating from 2 to 3 min with several pieces of broken Pyrex. This produced 100-percent cell breakage with very little generation of heat. These preparations, made from suspensions of 10,000 to 25,000 organisms, contained from 50 to 200  $\mu\text{g}$  nitrogen per milliliter. Nitrogen determinations were made by the method of Johnson (5).

Products of the reactions were determined chromatographically on Whatman No. 4 filter paper by the method of Lugg and Overell (6), using water-saturated n-butanol as the mobile phase, water as the stationary phase, and formic acid as a swamping acid to prevent ionization of the acids. All reaction mixtures were run in the presence of 0.02M phosphate buffer pH 7.4. They contained from 20 to 60  $\mu\text{g}$  paramecia nitrogen per milliliter. Three runs were made with 0.05M fumaric acid as substrate. These flasks also contained  $1.33 \times 10^{-6}\text{M}$  cytochrome c. Malic acid in each case was the only product detected. When 0.05M malic acid was used as substrate in the presence of 33  $\mu\text{g}/\text{ml}$  DPN (diphosphopyridinenucleotide) fumaric acid was detected in each case, and in each case it was the only product detected. With malic acid as the substrate, even in the presence of 33  $\mu\text{g}/\text{ml}$  DPN, 0.05M pyruvate, 15  $\mu\text{g}/\text{ml}$  coA,  $6.6 \times 10^{-6}\text{M}$  cytochrome c, and 250  $\mu\text{g}/\text{ml}$  adenosine triphosphate, fumaric acid was the only product of the reaction to be detected chromatographically. In every case, the chromatogram of the reaction mixture at zero time showed only the presence of the added substrate.

The presence of fumarase in cell-free preparations of *P. caudatum* has been detected by the use of paper-partition chromatography. Further work to determine whether other enzymes of the Krebs cycle might be detected by application of chromatographic techniques is indicated.

GERALD L. ENDAHL†  
KEATHA K. KRUEGER

Department of Biochemistry, School of Medicine,  
University of South Dakota, Vermillion

#### References and Notes

- \* This work has been supported in part by a grant from the U.S. Public Health Service.
1. L. C. Gilman, *Proc. S.D. Acad. Sci.* **26**, 43 (1946).
2. B. A. and G. F. Humphrey, *Nature* **159**, 374 (1947).
3. ———, *J. Exptl. Biol.* **25**, 123 (1948).
4. Manufactured by H. Mickle, Hampton, Middlesex, and distributed by C. A. Brinkmann and Co., Great Neck, L.I., N.Y.
5. M. J. Johnson, *J. Biol. Chem.* **137**, 575 (1941).
6. J. W. Lugg and B. T. Overell, *J. Sci. Research (Australia)*, Ser. A **1**, 98 (1948).
- † Present address: Oklahoma Institute for Medical Research, Oklahoma City.

13 September 1954.

### A Fungus Flora of the Sea

During the past 100 years, occasional curious individuals have sought fungi in salt water. If we discount unpublished and therefore unknown failures, we see that they were generally successful in their searches, but we also see that those searches were not followed up with the enthusiasm that has characterized studies on the taxonomy and ecology of other special groups. In a resumé of the subject, Wolf and Wolf (1) say, "Among students of fungi and marine biology generally, a knowledge of marine fungi is largely non-existent."

The reasons for lack of interest are not apparent. All marine organisms are important in the theoretical study of evolutionary relationships, and, according to Vishniac (2), "Marine micro-organisms are so little touched that it is safe to predict generally interesting biochemical results from almost any investigation of their nutrition." Furthermore, marine fungi promise to be of great economic importance (3). This is not commonly recognized, although they have been indicted as active agents in the destruction of plant and animal materials, both living and nonliving: eel-grass (4), diatoms (5), sea weeds (6), wood and fibers (7), and crab (8) and bivalve (9) larvae.

In connection with a marine borer survey, I have been making frequent collections of wood samples submerged in Limon Bay at the Atlantic end of the Panama Canal and in Panama Bay at the Pacific end. Using as great caution as possible to prevent chance contamination, I have isolated a number of fungus species directly from woody tissue. Immediate micro-

scopic examination always revealed vegetative hyphae among the wood fibers (Fig. 1). In three cases, fungi were isolated from marine organisms, although I do not know whether the fungi were parasitizing the organisms or living saprophytically. Algae yielded a *Tritirachium* and a *Pestalotiopsis*, and a tunicate bore fruit-bodies of the Ascomycete that Meyers (10) has provisionally called "Form No. 2."

Most of the genera thus isolated are imperfect fungi, and some, perhaps most, of the species have been found previously on land or in fresh water. However, they can and do inhabit salt water, they grow well on sea-water agar, and they are easily obtained throughout the year in this latitude. The genera in cultivation are *Aspergillus*, *Trisvirachium*, *Pestalotiopsis*, *Fusarium*, *Scopulariopsis*, *Phoma*, *Gonatorhodum*, *Mucor*, and some forms whose affinities are still unknown. Meyers (11) has also found *Halophiobolus* in my collections. So far, no species of *Penicillium* has been isolated, despite the extraordinary ability of the genus to tolerate wide osmotic variations. Several of the species collected here are apparently undescribed. They may simply be unknown land forms or they may be strict salt-water inhabitants. Specific determinations are being made.

One result of past marine fungus surveys that has retarded investigation is this common discovery, particularly close to shore, of forms already known from terrestrial habitats. These have been unanimously rejected as not "true" marine species, because they may also be found in habitats other than salt water. An interpretation of *true* that puts such a special meaning on the word is not strictly followed in other biological fields. To reject a terrestrial *Aspergillus* as a marine form because it does not occur exclusively in the sea is like rejecting the typhoid bacillus as a pathogen because it can live in water. One might, with equal justification, not accept *Aspergillus* as a terrestrial genus because it can be found in the ocean. A somewhat similar situation obtained in soil mycology in the early part of this century when the idea of a fungus flora of the soil had a doubtful reception until living hyphae were clearly demonstrated (12).

Sparrow (13) has emphasized that clear distinctions do not exist between aquatic, amphibious, and terrestrial fungi. There is certainly an active fungus

flora in the sea; and although some of the species are halophiles, many are able to thrive and reproduce in salt water or out of it.

DON RITCHIE\*

Naval Research Laboratory, Washington, D.C.

#### References and Notes

1. F. A. Wolf and F. T. Wolf, *The Fungi*, vol. II (Wiley, New York, 1947), p. 458.
2. H. S. Vishniac, *U.S. Armed Services Technical Info. Agency Document AD 23028*, 1 Jan. 1954.
3. C. E. ZoBell, *Marine Microbiology* (Chronica Botanica, Waltham, Mass., 1946), p. 134.
4. C. E. Kenn, *Biol. Bull.* 70, 148 (1936).
5. F. K. Sparrow, *Danske botan. Arkiv.* 3, 1 (1934).
6. G. K. Sutherland, *New Phytologist* 14, 183 (1915).
7. E. S. Barghoorn and D. H. Linder, *Forlowia* 1, 205 (1944).
8. J. N. Couch, *J. Elisha Mitchell Sci. Soc.* 50, 158 (1942).
9. H. C. Davis et al., *Science* 120, 36 (1954).
10. S. P. Meyers, *Bull. Marine Sci. Gulf and Carib.* 2, 500 (1953).
11. —, letter of 9 July 1954.
12. S. A. Wakaman, *Soil Sci.* 3, 565 (1917).
13. F. K. Sparrow, *Aquatic Phycomycetes* (Univ. of Mich. Press, Ann Arbor, 1943).

\* Present address: Barnard College, Columbia University, New York 27.

6 August 1954.

#### Submarine Photography in Puget Sound

There is no published information available on the operation of submarine bottom cameras from shipboard in the Puget Sound region. The present study (1) was undertaken to determine the feasibility of obtaining bottom photographs and to ascertain the most successful techniques to use. Subsequently, it is planned to utilize bottom photography as an aid in examining the bottom during biological, geologic, and physical studies.

Immediate use of the photographs obtained during this study is being made in an engineering study for the 230-kv cross-Sound electric power cable that is being contemplated by the Bonneville Power Administration. Depths of more than 700 ft at the 3½-mile crossing site just north of Seattle make direct examination of the bottom difficult. A second use has been found in assisting in the enumeration and identification of bottom-living organisms and in correlating the results of various bottom-sampling techniques near Anacortes, Wash. This is part of a study to determine biological conditions prior to establishment of industries that may cause pollution to the water.

An early Ewing type (2) shallow-water suspended assembly was strengthened for use in depths up to 1000 ft. A glass reflector (3) was substituted for the original reflector. The camera was a Robot rapid-sequence single-frame 35-mm camera with a Xenar *f* 2.8 lens. Plus x film developed in Microdol, No. 5 flashbulbs, and Kodabromide No. 4 enlarging paper developed in Dektol proved satisfactory. Results of numerous trials indicated that the most consistent results were obtained with the following camera and light settings: (i) aperture, *f* 8.0; (ii) exposure time, 1/100 sec; (iii) slant distance from camera to bottom,



Fig. 1. Photomicrograph ( $\times 500$ ) of vegetative fungus hyphae in fresh mount of wood, teased from a board submerged for 2 mo in Limon Bay, Panama, about 2 ft below the low-tide level.

7 ft; (iv) camera angle,  $35^\circ$  from vertical; (v) vertical distance from reflector to bottom, 3 ft; (vi) reflector angle,  $70^\circ$  from vertical.

Photographs were obtained in depths down to 850 ft at a number of locations in the Sound and neighboring waters. More than half of the exposures resulted in intelligible photographs. Two of the clearer and more detailed bottom photographs are shown in Figs.



Fig. 1. Bottom photograph taken in 76 m of water. The sloping firm mud bottom with a growth of sea anemones and hydroids is probably underlain with sand and gravel.

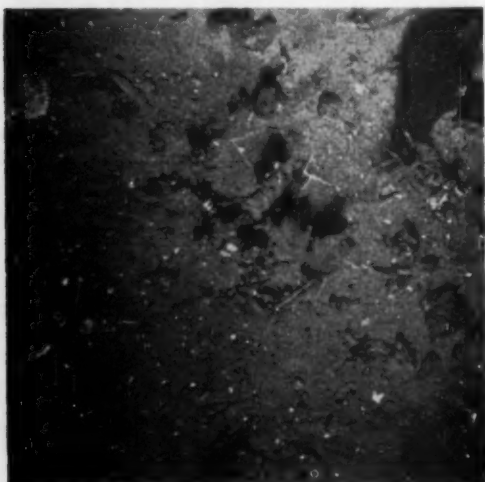


Fig. 2. Bottom photograph taken in 19 m of water. The undulating coarse sand bottom contains shell fragments, whole shells, and organic debris. Note the maple leaf in the center.

1 and 2. Owing to the turbidity of the water, the region is marginal from the standpoint of underwater photography. Even when the camera was set at only 7 ft slant distance from the bottom, most of the pictures show some haze and only a few are extremely sharp.

JAMES A. GAST

WAYNE V. BURT\*

Department of Oceanography,  
University of Washington, Seattle

#### References and Notes

1. Contribution No. 170 from the Department of Oceanography of the University of Washington. The work was carried out under contract N5onr-520/111, project NR 083 012, with the Office of Naval Research of the Navy Department.
2. M. Ewing, A. Vine, and J. L. Worzel, *J. Opt. Soc. Amer.* **36**, 307 (1946).
3. Pittsburgh Reflector Co., Pittsburgh, Pa. Trade name, Permaflexor.
- \* Present address: Oregon State College.

7 June 1954.

### Effect of Eruption of Hawaiian Volcanoes on the Composition and Carbon Isotope Content of Associated Volcanic and Fumarolic Gases

An opportunity was afforded during some recent eruptions of Hawaiian volcanoes to examine the gases issuing from a solfataric fumarole (Sulfur Bank, Hawaii National Park, Kilauea, Hawaii) that is in close physical association with the two active volcanoes of the island of Hawaii (Mauna Loa and Kilauea). The desirability of a systematic routine of analysis of fumarolic gases has long been recognized, and a start was made on such a project at Sulfur Bank by Ballard and Payne (1). These investigators also noted that the appearance of hydrogen sulfide at this fumarole seemed to be coincident with the eruption of nearby Mauna Loa (2).

In the present work (3) samples of gas were secured from pipes that were sunk at Sulfur Bank around 1922. Representative samples were obtained in gas sampling bulbs of both the evacuated and the sample-isolation types. These were removed to the laboratory and were subjected to analysis by a low-pressure technique (4) that was capable of analyzing gas samples as small as  $0.01 \text{ cm}^3$ , STP, and of detecting components present to the extent of 0.2 percent by volume. Some of the carbon dioxide was retained from certain of the samples and was purified by repeated complete distillation from liquid air traps for use in carbon isotopic analysis.

In one instance a sample of gas was secured from a still-hot lava flow (about  $700^\circ$  to  $800^\circ\text{C}$ ) in an evacuated metal collecting tube. Also a sample of rock from the same lava flow was heated in vacuum, and the gases evolved were collected. In each of these cases, the carbon dioxide was isolated and purified as described in the preceding paragraph and was submitted for isotopic analysis. By means of standards, the isotopic content of the samples was compared with the

Table 1. Analyses of gases collected from Sulfur Bank fumarole.

Sample tube	Constituents (vol %)					
	CO <sub>2</sub>	CO	H <sub>2</sub>	SO <sub>2</sub>	O <sub>2</sub>	N <sub>2</sub> (residue)
During an eruptive stage of Kilauea Volcano, July 1952						
1	97.4	1.0	0.4	1.5	0	0
2	97.6	1.4	0	1.8	0	0
3*	96.2	1.7	0.4	1.6	0	0
During a quiet stage of Kilauea Volcano, June 1953						
1a	10.9	3.2	0	0	13.6	71.5
1b†	10.6	2.2	0	0	15.1	70.7
2	10.2	2.9	0	0	13.2	71.8

\* No. 3 was a vacuum-bottle collection made at a later date than collections No. 1 and No. 2.

† Poor analysis.

Table 2. Stable carbon isotopic ratio in the carbon dioxide present in volcanic and Sulfur Bank fumarolic gases.

Gas sample	C <sup>12</sup> /C <sup>13</sup>
Sulfur Bank 1949, Mauna Loa in eruption	89.0
Sulfur Bank 1952, Kilauea in eruption	89.0
Sulfur Bank 1953, both volcanoes quiet	89.0
Gas collected from 1950 Mauna Loa lava flow	91.2
CO <sub>2</sub> extracted from Olivine Basalt of 1950 Mauna Loa lava flow	90.7

carbon dioxide from a Jurassic limestone that has been used as a primary standard by other workers, through the kindness of A. O. Nier (5). Isotopic ratio determinations of the carbon dioxide samples were made on the Consolidated-Nier type of mass spectrometer.

The results for the gas analyses are listed in Table 1. The great difference in the composition of the gas between times of eruption and quiescence of the nearby volcano is noteworthy. During the quiet period, there is strong indication of air contamination from the presence of nitrogen and oxygen in the gas. The possibility of using a systematic gas-analysis routine to detect changes in the proportions of the gaseous components with time and to use this as a predictive tool in volcanology immediately arises and, in fact, has been suggested previously.

The results for the determination of the carbon isotopic ratios are listed in Table 2. The significant points to be noted are (i) the constant value of the isotopic ratio of the carbon dioxide obtained from the Sulfur Bank fumarole despite the eruption or dormancy of the adjacent volcanoes and (ii) the "heaviness" of the fumarolic carbon dioxide when compared with the gas extracted from the lava or from above the active lava flow.

JOHN J. NAUGHTON  
KAZUJI TERADA

Department of Chemistry,  
University of Hawaii, Honolulu

## References and Notes

1. S. S. Ballard and J. H. Payne, *The Volcano Letter*, No. 460, July-Sept. 1940.
2. J. H. Payne and S. S. Ballard, *Science* **92**, 218 (1940).
3. We are deeply indebted to A. O. Nier of the Physics Department, University of Minnesota, for running some of the isotopic determinations, and to Earl Ingerson and Gordon A. Macdonald, U.S. Geological Survey, for aid and advice in the collection of the samples. Some of the early work on the preparation of the samples was done at the Frick Chemical Laboratory, Princeton University, and most of the work was aided by the Office of Naval Research, under contract Nonr-981(00), project NR 081 185.
4. S. Dushman, *The Scientific Foundations of Vacuum Technique* (Wiley, New York, 1949), p. 649.
5. A. O. Nier, *Phys. Rev.* **77**, 789 (1950).

13 September 1954.

## The Visiting Research Professor

Ten years ago Carl E. Seashore of the State University of Iowa, Emeritus Professor of Psychology, but called back to serve as Dean of the Graduate College, proposed [*Science* **100**, 218 (1944)] the appointment of retired persons who desire to continue their researches as *visiting research professors* at a neighboring university. Supporting his view he appointed two visiting research professors in 1944. As one of those fortunate persons, I can testify to the enormous benefits that have accrued to me. A stipend was granted sufficient to enable the appointee to spend 3 months in residence at the university or to defray the expenses of making frequent visits for longer or shorter periods. Most important has been the fellowship of the resident staff, and the incentive to keep on doing those things that one has been doing and hoping to continue to do. I commend the visiting research professorship to university administrators and to retired professors. It is immediately available. It meets the needs of elderly persons and increases the national scholarly output. And it requires no outlay for additional buildings, libraries, or laboratories.

HENRY S. CONARD

*Emeritus Professor of Botany, Grinnell College*

7 September 1954

## Psi and Probability Theory

The occurrence of significant deviations from mean expectancy in experiments in which guesses, cards, drawings, die faces, and so forth, are matched with targets has been attributed not only to psi (1) but also to error in the production, recording, selection, or analysis of the data. That these counterhypotheses to psi have been adequately refuted, either by ratiocination or by the performance of experiments in which the counterhypotheses were precluded, is testified to by the subsequent silence of their proponents. Two explanations for the results of these matching experiments have remained, namely (i) reality of psi and (ii) fallacy of probability theory. While there are comparatively few who have accepted the first explanation, there have been practically none, until recently,

who have voiced their acceptance of the second explanation. As unacceptable as psi theory may be, it has so far proved generally less unacceptable than the abandonment of probability theory.

Recently, however, an experiment has been reported by Brown (2), the results of which have caused him to question the validity of probability theory and the evidence for psi that rests upon it. In this experiment he matched "randomly selected columns of random digits" and obtained results that differ from the mean expectation by more than three standard deviations. If forthcoming, a detailed publication of the procedure and data of Brown's experiment may indicate that the results were producible by error in the production, selection, or analysis of the data. Otherwise (unless the improbable conclusion is accepted that this deviation with a  $p$  of less than .001 is the result of chance), there are two possible explanations for Brown's results: (i) they are the result of fallacy of probability theory, and (ii) they are the result of psi. While Brown recognized only the first explanation, the following considerations indicate that the second explanation is also a possibility.

Sections of a random series vary in degree of similarity and must be randomly selected so that their matching will constitute a valid test of probability theory. While Brown does not state the method by which the columns he matched were "randomly" selected, the method he used is not important since, if psi is real, any method of selection may be influenced by it. For example, if the columns were selected by cutting a book, the result may have been influenced by extrasensory perception; if they were selected by rolling a die, the result may have been influenced by psychokinesis (3); and if they were selected by the next day's temperature, the result may have been influenced by precognition. Even if the matched sections are chosen systematically, the choice of the system (of choosing the matched sections) may be influenced by psi. For example, if the chosen system is to match the first two columns, there existed the choice of matching two contiguous sections at the beginning of the series or some other pair, the choice of the length of the sections that were matched, and the choice of the table of random digits that was used. Since it is possible to

select two similar sections from a sensorily perceived random series, there is no valid reason to doubt that, if psi is real, two similar sections could be selected from an extrasensorily perceived random series. This is supported empirically by the significant results obtained with the "ESP shuffle" technique which consists of matching two series of cards whose symbols are not sensorily perceived (4).

The results of Brown's experiment add little to the evidence for accepting psi or abandoning probability theory that is not already provided by the results of other matching experiments. However, Brown's results may be differently received. Here, in an experiment designed to test the concept of randomness and which, therefore, may not be disregarded by those whose work is based on the validity of probability theory, are results that cannot be explained, unless they are attributed to chance, except by the alternatives of the reality of psi or the fallacy of probability theory. The results of Brown's and other matching experiments place statistical theorists, and those whose work is based on probability theory, in the unpalatable position of having to assert that psi is real in order to uphold the validity of probability theory. To make it doubly distasteful, if they accept psi they must admit its possible effect on the selection of "random" samples.

Perhaps the dilemma of accepting psi or abandoning probability theory will be completely resolved only if and when there is adequate experimental evidence for psi other than that based on probability theory. Until then the only logically defensible position is affirmation of psi or denial of probability theory.

CARROLL B. NASH

Department of Biology,  
St. Joseph's College, Philadelphia

#### References and Notes

1. Personal factors of processes in nature that transcend accepted laws.
  2. G. S. Brown, *Nature* **172**, 154 (1953).
  3. The direct influence exerted on a physical system by a subject without any known intermediate physical energy or instrumentation.
  4. J. B. Rhine et al., *Extra-sensory Perception after Sixty Years* (Holt, New York, 1940).
- 6 August 1954.

*A scientific hypothesis must live dangerously or die of inanition. Science thrives on daring generalizations. There is nothing particularly scientific about excessive caution. Cautious explorers do not cross the Atlantic of truth.—Lancelot Hogben, Science for the Citizen (1938).*

## Kodak reports to laboratories on:

getting rid of a stinker... toughening up our fastest photorecording paper...  
the photomechanical armamentarium... investigating photoelasticity

### Act of beneficence



This envelope came in postmarked Hindi Prachar Sabha a while back but bearing no sender's name or address, inside or out. All that was in it was a sheet of thin paper on which some devoted soul and poor typist had summarized an article about how Thioacetamide ( $\text{CH}_3\text{CSNH}_2$ ), neat, manageable, water-soluble solid, can replace classical, gaseous, unpleasant hydrogen sulfide for the precipitation of insoluble sulfides.

We thank our self-effacing correspondent from the bottom of our heart. We also blush. Here we have been making Thioacetamide (Eastman 1719) for years and years and had never gotten around to mentioning how it can ease one of the oldest and most noxious occupational hazards of our valued friends, the inorganic analysts. (Whoever says that we wanted them to turn to emission spectroscopy so that another division would sell more photographic plates and film is being unkind and unrealistic.)

Thanks to the prod from India, we have now prepared a rather expensive abstract on Thioacetamide analytical procedures for various Group II and III metals. This we shall be pleased to send as a gift to anyone willing to take the trouble to write to Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company). Our friend in India, if he will but identify himself unequivocally, can also have 100 grams of the reagent for his trouble and postage outlay. To others we make a slight charge of \$3.00 for 25 grams, or \$1.50 for 10 grams.

### 1127

Kodak Linagraph 1127 Paper is the fastest photorecording paper we know of for tungsten light. For technological reasons far too com-

plex to trouble you with, it is very difficult to make a photographic paper that fast and still have a durable emulsion. We speak frankly of this because the difficulty, formidable as it may have appeared, has now been surmounted.

All shipments of Linagraph 1127 for some months now have been going out with a physically hardened emulsion. Hereby withdrawn is the warning that this paper should be dried face out to avoid sticking. It can now be handled just the same as the slower Linagraph papers, but it still has the speed to record cathode-ray traces directly from green-emitting tube faces; and for moving mirror galvanometers this speed still permits wider trace amplitude, higher frequencies, and/or lower source intensity for less frequent electrical servicing.

If the fact that such paper exists is a revelation to you, we are glad. It is sold by Kodak Industrial Dealers in a variety of widths and winding specifications.

### Empirical miracles

A fair share of the bread and jam for our children and of the gasoline for our stockholders' outboards comes from the graphic arts industry. That covers photoengraving, photolithography, photogravure, screen process, and even a piece of straight commercial photography. The crafts are well established, committed to the principle of learning by doing. They do not fall all over themselves begging for advice from young scientists learned in quantum dynamics, yet somehow their product continually reaches new pinnacles of visual splendor.

We provide these practitioners with a complete line of sensitized materials, chemicals, lenses, filters, and auxiliary equipment, with which they proceed to work their empirical miracles. Unintentionally buried for years from the eyes of all but the photomechanical trade, there may be some item capable of working a particular empirical miracle that you have wanted to perpetrate. Ever hear of Kodalith Transparent Strip-

ping Film? Ever hear of Kodak Magenta Contact Screens? Of



### Kodak Autopositive Plates?\*\*\*

If you are working in a field in which it might be handy to know of such things, it's about time we offered you a free copy of the catalog that describes them. A new edition is just out.

Write Eastman Kodak Company, Graphic Arts Sales Division, Rochester 4, N. Y., and ask for "Kodak Materials for the Graphic Arts." If you find anything in it that evokes a glimmer of promise, write again for a free translation into non-photomechanical language and the name of the nearest dealer handling the product.

### Stress without strain

Photoelastic stress analysis is a technique for studying experimentally the relationships that link the shape of a solid body, the external mechanical forces acting on it, and the resultant internal forces. This is done by making a model out of transparent material and examining the induced birefringence pattern between crossed polarizers. Photography comes in because it is generally desired to record, compare, and ratiocinate about what is seen. Thick books and learned engineers are dedicated to this study, but if you want to find out just enough about it to decide whether it has any bearing on your problems, you buy from your Kodak Industrial Dealer for 35¢ a little Kodak Data Book entitled "Photoelastic Stress Analysis."

\*Finished picture can be split off from the film base.

\*\*High-precision two-dimensional dot array.

\*\*\*Gives a high-contrast positive direct from another positive, or a negative from a negative.

Prices quoted are subject to change without notice.

This is one of a series of reports on the many products and services with which the Eastman Kodak Company and its divisions are... serving laboratories everywhere

Kodak  
EASTMAN KODAK COMPANY

# SLEEPING ACCOMMODATIONS AT 121st AAAS MEETING

Berkeley, California, December 26-31, 1954

The hotel, motel, and dormitory sleeping accommodations—their rates and the application coupon below—are for your convenience in making room reservations in Berkeley. Please send your application *directly* to the AAAS Housing Bureau and thereby avoid delay and confusion. The experienced Bureau will make assignments promptly; a confirmation will be sent you in two weeks or less. **Single rooms may become scarce; double rooms for single occupancy cost more; if possible, share a twin-bedded room with a colleague—and also save.** Mail your application *now* to secure your first choice of desired accommodations. All requests for reservations must give a definite date and estimated hour of arrival and also probable date of departure.

HOTELS	SINGLE	DOUBLE	TWIN	SUITE
Claremont	5.00–11.00	8.00–13.00	8.00–13.00	14.00–20.00
Durant	4.00– 7.00	6.00– 9.00	6.50–10.00	10.00–16.00
Shattuck	5.00–10.00	7.00–10.00	7.50–10.00	10.00–18.00
Other hotels	3.00– 5.00	3.50– 5.00	4.00– 6.50	7.00–10.00
(Note: Most hotels have singles without private bath at \$2.00–\$3.50 per night)				
MOTELS				FAMILY ROOMS
Berkeley Plaza	5.00	6.00	7.00	8.50–12.00
California	4.00– 4.50	4.50– 5.00	5.50	6.00– 7.00
Golden Bear	4.50– 5.00	5.00– 7.00	6.00– 8.00	7.50–10.00
Other motels	4.00– 5.00	4.00– 6.00	5.50– 8.50	6.00–12.00

**Dormitory Accommodations:** NOTE: The 766 units in the University of California dormitories are primarily for students, younger faculty members, and those not on expense accounts. Occupancy, two persons per room; rate, \$2.00 the first night, \$1.00 per night thereafter, per person.

**International House:** Singles only, *without private bath*, \$2.50 per night.

For a discussion of the headquarters of the participating societies and sections, please see *Association Affairs, Science*, July 23, or *The Scientific Monthly*, August.

## ----- THIS IS YOUR HOUSING RESERVATION COUPON -----

AAAS Housing Bureau  
2223 Fulton Street  
Berkeley 4, California

Date of Application .....

Please reserve the following accommodations for the 121st Meeting of the AAAS in Berkeley, Dec. 26–31, 1954:

First Choice ..... Second Choice ..... Third Choice .....

(State name of hotel, motel, or other)

..... Single Room	Desired Rate .....	Maximum Rate .....
..... Double-bedded Room	Desired Rate .....	Maximum Rate .....
..... Twin-bedded Room	Desired Rate .....	Maximum Rate .....
..... Suite	Desired Rate .....	Maximum Rate .....
..... Dormitory Unit(s)—two persons per room at \$2.00 each first night, \$1.00 per night thereafter.		

**HOTEL AND MOTEL ROOM DEPOSIT**  
\$5.00 per reservation or \$10.00 per room (*refunded if cancelled before Dec. 17*)  
Make checks payable to "AAAS Housing Bureau."

The name and address of each person, including yourself, must be listed. Attach list if this space is insufficient.

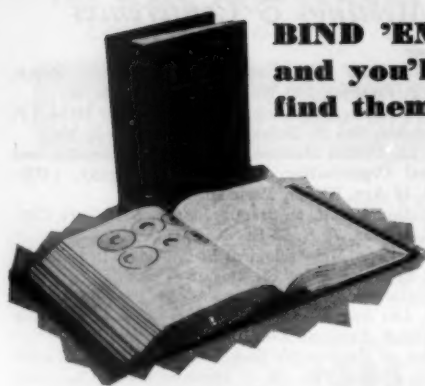
DATE OF ARRIVAL ..... DEPARTURE DATE .....  
(These must be indicated—add approximate hour, a.m. or p.m.)

NAME .....  
(Individual requesting reservation) (please print or type)

ADDRESS .....  
(Street) (City and Zone) (State)

My society (or sectional interest) is: .....  
I (will) (will not) have an automobile at the Meeting.

Mail this now to the Housing Bureau (address above). Enclose hotel or motel room deposit. Make checks payable to AAAS HOUSING BUREAU. Rooms will be assigned and confirmed in order of receipt of reservation.



**BIND 'EM...  
and you'll  
find them!**

Keep your copies of **SCIENCE** always available for quick, easy reference in this attractive, practical binder. Simply snap the magazine in or out in a few seconds—no punching or mutilating. It opens **FLAT**—for easy reference and readability. Sturdily constructed—holds 26 issues.

This beautiful maroon buckram binder stamped in gold leaf will make a fine addition to your library. Only \$2.75 postpaid (personal check or Money Order please). Name, 75¢ extra—year of issue, 50¢ extra. **ORDER YOURS NOW!**

**SCIENCE** • 1515 Mass. Ave., N.W., Washington 5, D. C.

## DIAGNOSTIC TOOLS

### 4-ACETYLAMINOANTIPYRINE

—for determination of body water

### PROTARGOL-S

—for staining nerve tissue

### WIN 3000

—for bone decalcification



*Winthrop Stearns* INC.

SPECIAL CHEMICALS DIVISION  
1450 Broadway, New York 18, N. Y.

**J**ust Published

## BIOCHEMICAL DETERMINANTS OF MICROBIAL DISEASES

By **René J. Dubos**  
Member of the Rockefeller Institute  
for Medical Research

Diseases caused by bacteria are commonly referred to as "infectious," yet it is obvious that infectious bacteria can multiply in the tissues of man or animals without giving rise to lesions or symptoms. In the past emphasis has been placed on preventing infection and treating the sick patient, and little has been known of the factors which cause infection to evolve into overt disease.

The specific purpose of this important book is to present a critical analysis of the chemical factors in normal tissues which determine susceptibility or resistance to microbial diseases. The author also considers the role of these factors in the reactions of acquired immunity.

Dr. Dubos organizes his discussion of these newly considered problems into the following chapters: *Infection into Disease; The Fate of Microorganisms in vivo; Biochemical Disturbances Produced by Infection; Selected Topics in Tuberculosis; Immunity and Inflammation.*

Widely known for his research and writings in the field of infectious diseases, Dr. Dubos is the author of *The White Plague—Tuberculosis, Man and Society*; *Louis Pasteur—Free Lance of Science*; *Bacterial and Mycotic Infections of Man*; and *The Bacterial Cell*. This is #12 in the Harvard University Monographs in Medicine and Public Health.

\$3.50 at your bookseller, or



**HARVARD University Press**

44 Francis Avenue  
Cambridge 38, Massachusetts

## Outstanding

### McGRAW-HILL BOOKS

#### SURGICAL TECHNIGRAMS

By F. M. AL AKL, M.D., Associate Attending Surgeon, Kings County Hospital, New York. 360 pages, \$12.00

Emphasizing the technical aspect of anatomy as seen through the surgeon's eye, this concise book of reference presents the techniques of basic operative procedures, with emphasis on the *anatomics* of surgery. It is intended to give both fundamental surgical instruction and "night-before-the operation" briefing, and covers only the actual operative manipulation, dividing each procedure into a number of consecutive steps, and describing each step in terms of detailed surgical anatomy.

#### AN OUTLINE OF DEVELOPMENTAL PHYSIOLOGY

By CHR. P. RAVEN, University of Utrecht, The Netherlands. 234 pages, \$5.50

A distinguished contribution to the field of embryology. The book deals with the causal factors of development i.e., the causes of all changes, leading from the fertilized egg to the adult organism. The subject matter is presented from the viewpoint that development may be regarded as a transformation of intensive (non-spatial) multiplicity into extensive (spatial) multiplicity. The treatment is theoretical but simple, and the book is intended for undergraduate and postgraduate students.

#### ANALYTICAL CYTOLOGY

Edited by ROBERT C. MELLORS, Sloan-Kettering Institute for Cancer Research. In press

A group of authors, each an authority in his field, have brought together some of the newer physical and chemical methods for studying cellular form and function. Newer developments and applications of the microscope are discussed in terms of theory and application to biological problems. In addition to the use of light in cytological analysis, other methods using forms or carriers of radiant energy, such as electron microscopy and autoradiography, are included. The more important staining methods are also reviewed. Extensively illustrated with diagrams and halftones.

Send for copies on approval

**McGRAW-HILL BOOK COMPANY, Inc.**

330 West 42nd Street • New York 36, N. Y.

## Meetings & Conferences

### November

- 11-13. American College of Cardiology, Miami Beach, Fla. (P. Reichert, 140 W. 57 St., New York 19.)
- 12-13. Inter-Society Cytology Council, Boston, Mass. (P. F. Fletcher, 634 N. Grand Blvd., St. Louis 3, Mo.)
- 12-Dec. 11. United Nations Educational, Scientific, and Cultural Organization, Montevideo, Uruguay. (UNESCO, 19 Ave. Kléber, Paris 16.)
- 15-17. National Conf. on Standards, 5th, New York City. (D. E. Denton, 70 E. 45 St., New York 17.)
- 17-19. American Meteorological Soc., Miami Beach, Fla. (K. C. Spengler, 3 Joy St., Boston 8, Mass.)
- 18-19. National Assoc. of Corrosion Engineers, western region, Los Angeles, Calif. (J. G. Kerr, C. F. Braun & Co., 1000 S. Fremont Ave., Alhambra, Calif.)
- 18-19. Soc. of Exploration Geophysicists, 8th annual mid-western, Dallas, Tex. (R. C. Dunlap, 624 S. Cheyenne, Tulsa, Okla.)
- 18-20. Acoustical Soc. of America, semiannual, Austin, Tex. (W. Waterfall, 57 E. 55 St., New York 22.)
- 18-20. Symposium on Precision Electrical Measurements, Teddington, Eng. (Director, National Physical Laboratory, Teddington, Middlesex, Eng.)
- 19-20. Operations Research Soc. of America, Washington, D.C. (D. A. Katcher, 7100 Connecticut Ave., Chevy Chase 15, Md.)
- 19-20. International Cong. of Civil Engineers, 2nd, Caracas, Venezuela. (L. B. Diaz, Av. Principal de los Caobos, Apartado 2006, Caracas.)
- 25-26. Inst. of Metals, London, England. (S. C. Guillan 4, Grosvenor Gardens, London, S.W. 1.)
- 26-27. American Physical Soc., Chicago, Ill. (K. K. Darrow, Columbia Univ., New York 27.)
- 26-27. American Soc. of Animal Production, Chicago, Ill. (W. M. Beeson, Dept. of Animal Husbandry, Purdue Univ., Lafayette, Ind.)
- 26-27. Tennessee Acad. of Science, Nashville, Tenn. (I. H. Tipton, Physics Dept., Univ. of Tennessee, Knoxville.)
- 28-1. American Soc. of Refrigerating Engineers, Philadelphia, Pa. (J. I. Szabo, 40 W. 40 St., New York 18.)
- 28-9. American Soc. of Mechanical Engineers, annual, New York City. (O. B. Schier, II, 29 W. 39 St., New York 18.)
- 29-1. Assoc. of Military Surgeons, Washington, D.C. (R. R. Sayers, Armed Forces Inst. of Pathology, Washington 25.)
- 29-2. American Medical Assoc., clinical, Miami, Fla. (G. F. Lull, 535 Dearborn St., Chicago 10, Ill.)
- 30-2. Electronic Computer Clinic, 1st, New York, N.Y. (R. Rimbach, 845 Ridge Ave., Pittsburgh 12, Pa.)

### December

- 1-2. Animal Care Panel, Chicago, Ill. (R. J. Flynn, Box 299, Lemont, Ill.)
- 1-3. American Rocket Soc., New York, N.Y. (ARS, 33 W. 39 St., New York 18.)
- 1-7. International Cong. on Medicinal and Similar Plants, São Paulo, Brazil. (P. Artigas, Rua Tres Rios 363, São Paulo.)
- 1-8. Pan American Pharmaceutical and Biochemical Cong., 3rd, São Paulo, Brazil. (C. Fontoura, Rua Caetano Pinto 129, São Paulo.)
- 3-4. Oklahoma Acad. of Science, Tulsa, Okla. (R. E. Olson, Dept. of Geography, Univ. of Oklahoma, Norman.)

## THE NMC PROPORTIONAL COUNTER CONVERTER

### Ideal for Soft Betas



- No window absorption • 2% geometry
- Full yield & counting • Differentiates between  $\alpha$  and  $\beta$
- Negligible resolution loss • Adapts any scaler to proportional counting • Rapid decontamination

MODEL PCC-10

**\$385.00**

F.O.B. INDIANAPOLIS

**FREE CATALOG**

Catalog S-8 covers NMC's complete line of nuclear instruments.



**Nuclear Measurements Corp.**

2460 N. ARLINGTON AVE. • INDIANAPOLIS 18, IND.

FROM A  
SINGLE SOURCE!

REAGENT CHEMICALS  
ORGANIC CHEMICALS  
BIOLOGICAL STAINS  
CHEMICAL INDICATORS  
SOLUTIONS  
TEST PAPERS



## BLOOD STAINS

The MC & B list of Biological Stains includes a complete list of stains certified by the Biological Stain Commission.

MATHESON, COLEMAN & BELL PRODUCTS  
ARE DISTRIBUTED BY LABORATORY AND  
PHYSICIAN SUPPLY HOUSES  
THROUGHOUT THE WORLD

Send for our New Catalog #27  
Covering over 3911 Products.



DIVISION OF THE MATHESON CO., INC.

EAST RUTHERFORD, NEW JERSEY • NORWOOD (CINCINNATI), OHIO

*Now available...*

Adenosine Triphosphate (ATP); Amygdalin; Amylase; Animal Lecithin; Ascorbic Acid Oxidase; Bacitracin; BAL; Biotin, cryst.; Caffeic Acid; Carotene, cryst.; Catalase; Cellulase Chlorogenic Acid; Chorionic Gonadotropin; Circulatory Hormone; Colchicine; Cytidylic Acid; Cytochrome C; Dehydroascorbic Acid; Diacetoneamine; Dihydroxyacetone; Dihydroxyphenylalanine (DOPA); Dipyrrolyl; Edestin; Emulsin; Erythritol; N-Ethylpiperidine; Fibrin; Folic Acid; Galacturonic Acid; Gentisic Acid; Girard Reagents P and T; Gliadin; Glucose Pentaacetate; Glucuronic Acid; Glyceraldehyde; Glyceric Acid; Heparin; Horde-nine; Hyaluronidase; Hydrindene; 2-Hydroxyadipaldehyde; Humulon; Indan; Isoascorbic Acid; Isopropyl-arterenol; Kojic Acid; Kynurenic Acid; Lanthionine; Lipase; Lysozyme; Lyxose; Malononitrile; Maltase; Melzitose; Mesobilirubinogen; Muscle Adenylic Acid; p-Nitrophenylphosphate; Nucleoprotein; Orcinol; Pan-creatin; Pentothetyl Alcohol; Penicillinase; Peroxidase; Phenazine; Phenylpyruvic Acid; Phloridin; Phosphory-lase; Piperin; Porphyrindine; Protamines; Protoporphy-rin; Pyridoxal; Pyridoxamine; Pyrocatechuic Acid; Pyruvic Aldehyde; Ribonuclease; Saccharic Acid; Sal-mine; Serine Phosphoric Acid; Spermidine; Spermine; Thioacetic Acid; Thiocytosine; Thyroxine; Trigonelline; Triphenyltetrazolium Chloride; Tripyridyl; Trypsino-gen; Tyrosinase; Tyrothricin; Urease; Uricase; Uri-dine; Vitellin; Xanthosine.

Ask us for others!

**DELTA CHEMICAL WORKS, INC.**

23 West 60th St. New York 23, N.Y.

Telephone PLaza 7-6317

*Send for Your Free Copy  
New "REVIEW" of...*

- GALVANOMETERS\*
- MICROPHOTOMETERS
- THERMOPILES
- SPECTROMETERS
- MONOCHROMATORS

P. J. Kipp & Zonen, of Holland, world renowned manufacturers of these and other specialized scientific instruments, have issued the first complete catalog of their line. Your copy will be mailed as soon as we receive your request. Please ask for "Review #50-S."

We are the exclusive United States representatives for Kipp & Zonen. Your correspondence is invited on any precision apparatus problem where we may be able to serve you.

\*Immediately available in many types

**JAMES G. BIDDLE CO.**

Electrical & Scientific Instruments

1316 ARCH STREET, PHILADELPHIA 7, PA.

# PERSONNEL PLACEMENT

YOUR ad here reaches over 32,000 foremost scientists in the leading educational institutions, industrial laboratories, and research foundations in the U. S. and 76 foreign countries — at a very low cost

**CLASSIFIED:** 18¢ per word, minimum charge \$3.60. Use of Box Number counts as 10 additional words.

**DISPLAY:** Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	\$19.50 per inch
7 times in 1 year	17.50 per inch
13 times in 1 year	16.00 per inch
26 times in 1 year	14.00 per inch
52 times in 1 year	12.50 per inch

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

## POSITIONS WANTED

Biochemist, Ph.D., 27, currently holding temporary teaching and research position at Medical School will be available June 1955. Box 251, SCIENCE. 10/15

(a) Clinical psychologist; Ph.D.; since 1948, chief department, clinical psychology, large hospital. (b) Pharmacologist; Ph.D.; extensive experience in circulatory physiology, autonomic pharmacology and general pharmacology. Medical Bureau (Burnice Larson, Director) Palmolive Building, Chicago. X

## POSITIONS OPEN

Bacteriologist or A.S.C.P. trained technician. Apply Augustana Hospital, 411 West Dickens Ave., Chicago, Illinois. 10/1, 8

Chemist (Senior Research)—Ph.D. in organic chemistry with minor in biological sciences and preferably a second minor in physical chemistry. 1 to 5 years' research experience. Position requires broad knowledge of organic syntheses and interest in and experience with natural products and synthetic organic chemistry, personally suited to group activity plus ability to supervise assistants. Philadelphia location. Excellent benefit program. Send complete resume to Box 250, SCIENCE. X

Progressive Eastern pharmaceutical company desires competent, well-trained pharmacologist of demonstrated research ability to join research staff engaged in broad investigation of new medicinal agents. Opportunity for advancement and publications. Salary commensurate with ability and experience. Our employees know about this opening. Box 252, SCIENCE. 10/22

(a) Research assistant; radiation therapy department; new research laboratory with expanded radio-isotope facilities within year; research and radiation therapy experience preferred; research in other area of medicine considered; large teaching hospital; East. (b) Research food technologist qualified to supervise staff of ten; Ph.D.; with minimum two years' experience; East. (c) Physician with flair for medical writing to join staff department of professional relations, pharmaceutical company. (d) Clinical pharmacologist; department of clinical research; one of leading companies; Midwest. (e) Physiologist; crime laboratory; duties; assisting in crime solutions, analyses, pharmacological preparations. (f) Instructor in pharmacology; medical school; East. S10-2 Medical Bureau (Burnice Larson, Director) Palmolive Building, Chicago. X

Wanted: Pathologist to conduct toxicity and tissue studies. Ample opportunity for research. Well trained M.D., D.V.M., or Ph.D., in pathology acceptable. Write Employment Manager, Abbott Laboratories, North Chicago, Illinois. 10/15; 22

**OCT. 22.**  
**EQUIPMENT ISSUE**  
Send your copy in, now!

## POSITIONS OPEN

**SCIENTISTS—Salaried Positions, \$6,000 to \$35,000**

This confidential service for outstanding Chemists, Engineers, Physicists, Metallurgists, etc. who desire a change of connection, will develop and conduct preliminary negotiations without risk to present position. Send name and address for details.

**TOMSETT ASSOCIATES** • 435 Frick Bldg., Pittsburgh 19, Pa.



## The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

**CLASSIFIED:** 25¢ per word, minimum charge \$6.00. Use of Box Number counts as 10 additional words. Correct payment to SCIENCE must accompany ad.

**DISPLAY:** Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	\$19.50 per inch
7 times in 1 year	17.50 per inch
13 times in 1 year	16.00 per inch
26 times in 1 year	14.00 per inch
52 times in 1 year	12.50 per inch

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

## BOOKS AND MAGAZINES

**WANTED TO PURCHASE . . .**  
**SCIENTIFIC PERIODICALS and BOOKS** } Sets and runs, foreign and domestic. Entire libraries and smaller collections wanted  
**WALTER J. JOHNSON** • 125 East 23rd St., New York 10, N. Y.

## Your sets and files of scientific journals

are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, J. S. CANNER, INC. Boston 19, Massachusetts

## THE LOGIC OF MODERN SCIENCE

By J. B. KANTOR

375 pages

\$6.00

Principia Press, Inc., Bloomington, Indiana

## PROFESSIONAL SERVICES

## ANALYSIS OF AMINO ACIDS AND PROTEINS

VITAMINS, MINERALS,  
FOODS,  
SPECIAL DETERMINATIONS

**SHANKMAN LABORATORIES**

2023 SANTA FE AVENUE, LOS ANGELES 21, CALIFORNIA

# The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT



## PROFESSIONAL SERVICES

WISCONSIN  
ALUMNI  
RESEARCH  
FOUNDATION

### LABORATORY SERVICES

Project research and consultation in Biochemistry, Chemistry, Bacteriology and Entomology

Mineral determinations including sodium and fluorine • Proximate analyses • Vitamin and amino acid assays • Food chemistry and microbiology • Enzyme investigations

Write for price schedule

WISCONSIN ALUMNI RESEARCH FOUNDATION  
P. O. BOX 2059-V • MADISON 1, WISCONSIN



### FOOD RESEARCH LABORATORIES, INC.

Founded 1922

Philip B. Hawk, Ph.D., President

Bernard L. Oser, Ph.D., Director

Research • Analyses • Consultation  
Biological, Nutritional, Toxicological Studies  
for the Food, Drug and Allied Industries  
48-14 33rd Street, Long Island City 1, N.Y.

• RESEARCH

• CONSULTATION

• ANALYSES

## CONSULTATION RESEARCH

MICROBIOLOGY  
PHARMACOLOGY  
BIOCHEMISTRY  
TOXICOLOGY  
ANIMAL HISTOPATHOLOGY

SOUTH SHORE

ANALYTICAL AND RESEARCH LABORATORY, Inc.  
148 ISLIP AVE. ISLIP, N. Y.

## LOOKING FOR A PUBLISHER?

Write for Free Booklet SC telling how we can publish your book. All subjects considered. New authors welcome.

VANTAGE PRESS, Inc. • 120 W. 31 St., New York 1  
In Calif.: 6356 Hollywood Blvd., Hollywood 28

SINCE 1870



Food Ingredient & New Drug Studies

### BIOLOGIC ASSAYS

LaWall & Harrison

Div. S, 1821 Walnut St., Philadelphia 3, Pa.

Bacteriologists

Chemists • Pharmacologists

ANALYSES • CONSULTATION • RESEARCH

## SUPPLIES AND EQUIPMENT

### All AMINO ACIDS—

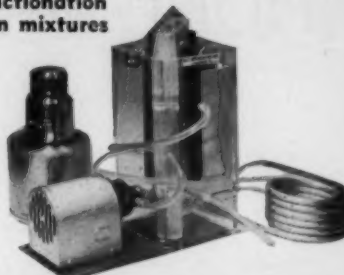
natural, synthetic, unnatural,  
Rare Sugars, Biochemical Products, Reagents, New  
Pharmaceuticals in stock. Write or phone PLaza  
7-8171 for complete price list.

BIOS LABORATORIES, INC. 17 West 60th Street,  
New York 23, N. Y.

## SUPPLIES AND EQUIPMENT

### ELECTROCONVECTION

for fractionation  
of protein mixtures



See:

Proc. Soc. Exp. Biol. Med. v. 81, p. 278  
(1952)

Send for free bibliography of electrophoresis-convection

E-C APPARATUS CO. 27 Haven Avenue  
New York 32, N. Y.

## technicon

offers precision equipment for the  
histology and chemical laboratory.  
215 East 149th Street • New York 51, N. Y.

## SPRAGUE-DAWLEY, INC.

### Pioneers in the development of the STANDARD LABORATORY RAT

Our new modern colony building just completed soon will double our present production.

The new colony building contains every device to insure continuous production and shipment of guaranteed Sprague-Dawley strain white rats.

Limited shipments of males from the new colony will be available about March 15, 1954.

Increased orders from our present customers and orders from new customers will be accepted as production builds up.

OUR PLEDGE: Our insistence on the highest possible quality will never be sacrificed to quantity.

SPRAGUE-DAWLEY, INC. P.O. BOX 2071  
Madison, Wisconsin

# The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT



SUPPLIES AND EQUIPMENT

SUPPLIES AND EQUIPMENT

## HOLTZMAN RAT COMPANY

... Continuity of Quality & Dependability of Supply

Route 4, Badger Lane

Madison 5, Wisc.

Phone 6-5573

• Hamsters • Guinea Pigs • Rabbits •  
**MANOR FARMS**  
 Staatsburg, New York  
 Tel. Staatsburg 3278  
 Supplying every Research Need Since 1943

**RESEARCH**

Mice Rats Cats Dogs

**Ask For GBI Price List**

GBI research products, in convenient small packages—are offered as a special service to investigators. They will save you time, trouble and expense if you are engaged in research in these fields.

Write for this useful reference book listing hundreds of items for research.

**BIOLOGICAL**  
**MICROBIOLOGICAL**  
**BACTERIOLOGICAL**  
**BIOCHEMICAL**  
**NUTRITIONAL**

...GBI... **General Biochemicals, Inc.**  
 72 LABORATORY PARK, CHAGRIN FALLS, OHIO

**TACONIC FARMS**  
 Germantown, N. Y.  
 Germantown 3535

• Swiss Mice  
 • Webster Strain

**BEAGLES**

Healthy — AKC Registered — Immunized  
 \$25 to \$50 each; F.O.B. Ithaca  
 J. FATULA — Dog Farm — RRI — Ithaca, N. Y.

**MACHLETT**

Your assurance of the finest laboratory supplies, scientific instruments, chemicals and glassblowing.

E. Machlett & Son • 220 E. 23rd St. • N. Y. 10, N. Y.

**RATS** Long-Evans (PAF)  
 Wistar (PAF)

Bred for Research Work by Research Workers  
**PACIFIC ANIMAL FARMS**  
 2457 Fletcher Dr., Los Angeles 39, Calif.

**STAINS** RARE • COMMON  
 Price list on Request  
**STARKMAN Biological Laboratory** • 461 Bloor St., W. Toronto, Canada

**MICROSCOPE ILLUMINATORS**  
 NEW FEATURES...YOUR CHOICE OF 5 MODELS

**ALL-PURPOSE** 32" **BRIGHT BEAM** 27"

**VBM '95** Variable Intensity Illuminator and Microscope  
**BM '65** Brilliant illumination Microscope  
**SS '35** Small recharge lamp with brightest light

5 best buys backed by Lindly Engineering give you precision built technical lamps to complement the finest microscopes.

**LINDLY** FOREMOST IN MICROSCOPE LAMPS  
 See your dealer or write  
**LINDLY & CO., INC., MINEOLA, N. Y.**

**• HYPOPHYSECTOMIZED RATS**

Shipped to all points via Air Express  
 For further information write  
**HORMONE ASSAY LABORATORIES, Inc.** • 8159 South Spaulding Ave. Chicago 29, Ill.

# *A New International Centrifuge*



## FOR THE *Modern Laboratory*

The new INTERNATIONAL MODEL U is more than just a Centrifuge in a cabinet. International's experienced engineering has produced a Centrifuge with years-ahead features and unmatched performance.

**Y**OU will want to know more about the new aerodynamic guard bowl ventilating system—the new stainless steel interior—the stainless steel auxiliary cover that saves valuable bench space—the electric tachometer—the electric time clock—the unique air-filtering system—the spring-loaded hinge—the new vibration dampening system which results in smooth

operation without the “shaker” action of over-flexible mountings—the versatility of 84 interchangeable accessory combinations.

Let us tell you more about this completely new Centrifuge, handsomely designed to fit in with your wall counters and cabinets. Write for Bulletin J explaining all these features in detail.

**INTERNATIONAL EQUIPMENT COMPANY**

1284 SOLDIERS FIELD ROAD, BOSTON 35, MASS.

# TEST TUBE BASKETS

- ▶ Rustproof
- ▶ Lightweight
- ▶ Rigid and durable



**TEST TUBE BASKETS, Rustproof.** Of expanded aluminum sheet, reinforced at top, bottom and seams, and with rounded edges; providing an excellent lightweight but rigid and durable container which does not require a protective surface coating or finish and which will withstand indefinite hot air or steam pressure sterilization. Dimensions specified are overall measurements.

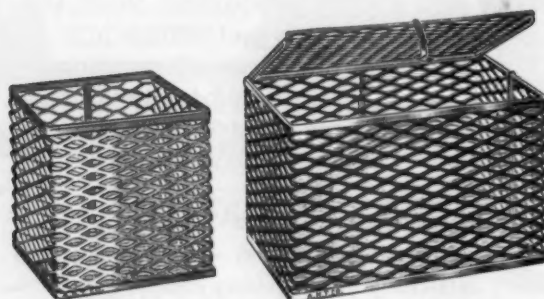
**9479-A. Test Tube Baskets, Rustproof, Cylindrical, as above described, without cover.** Inside depth is approximately  $\frac{3}{4}$ -inch less than overall height.

Diameter, inches	5	10
Height, inches	6	6
Each	2.45	3.02

**9479-B. Test Tube Basket, Rustproof, Cylindrical, Partitioned.** Similar to 9479-A, size 10 x 6 inches, but with removable insert—also of expanded aluminum sheet—for dividing the basket into four sections, with a central cylinder approximately 1-inch diameter. This insert facilitates loading and insures effective circulation of steam to test tubes at middle of loaded basket when used in steam pressure sterilizer. Without cover . . . . . 5.52

**9479-B2. Removable Insert, only, as supplied with 9479-B** . . . . . 2.50

**9479-B4. Cover, only, for use with 9479-A Cylindrical Basket size 10 inches diameter.** Of expanded aluminum sheet, with reinforced edges and with three Stainless steel spiral springs with finger grips for fastening to basket . . . . . 2.00



9479-C.

9479-D.

**9479-C. Test Tube Baskets, Rustproof, Rectangular, otherwise identical in construction with 9479-A.** Inside depth is approximately  $\frac{3}{8}$ -inch less than overall height.

Length, inches	4	5	5	6
Width, inches	4	4	4	6
Height, inches	6	4	6	6
Each	2.45	2.30	2.52	3.17

Length, inches	10	11 $\frac{1}{2}$	12 $\frac{7}{8}$
Width, inches	6	7 $\frac{3}{8}$	9
Height, inches	6	7	7
Each	3.60	4.26	4.72

**9479-D. Covers, only, for use with 9479-C Rectangular Baskets.** Of expanded aluminum sheet with reinforced edges, and with two Stainless steel springs with finger grips for fastening to basket.

Size, inches	4 x 4	5 x 4	6 x 6
Each	1.15	1.15	1.20
Size, inches	10 x 6	11 $\frac{1}{2}$ x 7 $\frac{3}{8}$	12 $\frac{7}{8}$ x 9
Each	1.25	1.50	1.60

10% discount in lots of 12, one size and catalogue number only.



## ARTHUR H. THOMAS COMPANY

*Laboratory Apparatus and Reagents*

WEST WASHINGTON SQUARE

PHILADELPHIA 5, PA.

Teletype Services: Western Union WUX and Bell System PH-72

